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THE AMERICAN GAS LIGHT JOURNAL

REDMANKENNY, N.Y.

PUBLISHING OFFICE No. 32 PINE STREET

DEVOTED TO THE INTERESTS OF ILLUMINATION, HEATING, MECHANICAL, CHEMICAL AND GENERAL SCIENCE.

VOLUME LXIX. No. 20. Whole No. 1,223. | NEW YORK, MONDAY, NOVEMBER 14, 1898 | $3 PER ANNUM, IN ADVANCE.

A. M. CALLENDER & CO., Proprietors. C. E. SANDERSON, Manager.
THOMAS J. CUNNINGHAM and ELBERT P. CALLENDER, Editors.

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y., AS SECOND-CLASS MATTER.

Published on each Monday of the year, at No. 32 Pine Street, New York.

Collections are invariably made directly from this office for subscriptions, advertisements, etc. We have agents to solicit the same, but they are not authorized to receipt for money.

Terms of Subscription, Including Postage—For the United States and Canada, $3 per annum. European countries, $4.50 (19 shillings—22½ francs). All payments to be made in advance. Single copies, 10 cents.

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BRIEFLY TOLD.

MR. WALTON FORSTALL'S "NOTES ON MAINS AND MAIN LAYING."—The paper, read at the last meeting of the American Gas Light Association, by Mr. Walton Forstall, of Philadelphia, the caption of which is, "Notes on Mains and Main Laying"—its text and the discussion will be found elsewhere in this issue of the JOURNAL—is of the sort that commends it to gas engineers sufficiently to cause them to put it where it will be handy for future reference. While the author has not advanced any startlingly new theories respecting current practice in main laying, he has concisely put together a valuable lot of matter for the safe guidance of those whose main laying operations are in the districts that hold large populations; and many of his rules will also apply to places of small populations. Of a necessity statistical matter predominates in the paper, but the statistics supplied are of a nature that will always cause them to be of living interest to his fellow workers. The discussion brought out by the paper is notable for its vigorousness, and for the free interchange of opinion respecting the debaters' views over the details of main laying. Mr. Forstall, in any event, is well qualified to speak to the subject that he selected, for gas men the country over appreciate the tremendous task that was put upon him when he was named to and accepted the work of overseeing the changes necessary in the main system of the Philadelphia gas works, to cause that plant to reasonably respond to the demands of the gas consumers of Philadelphia. To say that chaos ruled in the gas main system of Philadelphia when under municipal operation is indeed a mild way of putting it; to say that it is now sensibly complete would also be an exaggeration. But to say that Mr. Forstall has reformed it much and will improve it more is to state the fact.

TABLE FOR HOUSE PIPING ADOPTED BY THE AMERICAN GAS LIGAT ASSOCIATION.—At the meeting this year of the American Gas Light Association the Committee on Research proposed a table for house piping, and the Association subsequently adopted the schedule submitted. Its provisions are—

$$Q = 1{,}350 \sqrt{\frac{d^5 p}{\frac{1}{2} l g}}$$

Loss of pressure assumed, $\frac{1}{10}$ inch of water for 50 feet of pipe.
d = diameter in inches.
p = pressure in inches of water.
l = length of pipe in feet.
g = specific gravity of gas compared with air.
Q = cubic feet of gas per hour.
"g" assumed to be .680.
"d" and "l" assumed; "Q" calculated.

d	l	Q	d	l	Q
⅜	20	11	1½	150	349
½	30	22	2	200	718
¾	50	60	2½	300	1,255
1	70	127	3	450	1,977
1¼	100	222	4	600	4,059

"Q" is the maximum duty per hour for pipe of the length and diameter given. No greater length of pipe should be used than is

given in the table; *e. g.*, the maximum length of 1-inch pipe allowable under any circumstances is 70 feet, and it should not be expected to carry over 127 cubic feet of gas per hour.

Death of Mrs. A. B. Slater.—We regret to report the death of Mrs. Ruth Mathews Slater, wife of Mr. A. B. Slater, Treasurer and Secretary of the Providence (R. I.) Gas Company. Her death occurred, at her home in Providence, on the 8th inst. She was in her 66th year.

Notes.—Mr. H. M. Buck has been appointed Superintendent of the Waukesha (Wis.) American Gas Company.——The municipal gas plant at Hamilton, Ohio, is being remodeled to manufacture coal gas.——A certificate announcing the incorporation of the Clinton Gas Company, to make, distribute and sell gas in Essex, Hudson and Union counties, New Jersey, has been filed. Its initial capital stock is $100,000, and its principal office is to be located in Newark.——We have to chronicle the death of Mr. William Boyle, gas auditor, office of City Comptroller, Philadelphia. His demise occurred on the 4th inst. He was in his 50th year.——At an election of the shareholders in the Buffalo (N. Y.) City Gas Company the following Directors were chosen: Emerson McMillin, Henry Seligman, Stephen Peabody, H. H. Littell, Robt. C. Pruyn, Robt. L. Fryer, D. O'Day, Chas. Berrick, B. C. Rumsey, F. D. Locke and W. F. Douthirt.——Mr. W. H. Fritchman has completed the sale of the plant and franchises of the Norwalk (Conn.) Gas Light Company to the syndicate headed by Mr. A. M. Young, of Waterbury, Conn.——A correspondent informs us that there is talk that there may not be any great competition in the gas lighting business in Trenton, N. J., after all. He suggests that the Delaware River Power and Improvement Company, which recently acquired control of all the electric interests of Trenton, may absorb the two gas companies.——An attempt is underway to resuscitate the suspended concern known as the Kalamazoo Gas and Electric Company.——Mr. William A. Cutter, of Buffalo, N. Y., is endeavoring to purchase the natural gas outfit that is controlled and operated on municipal account at Findlay, Ohio.——The 50th annual meeting of the Consumers' Gas Company, of Toronto, Can., was a most satisfactory reunion. The reports for the year showed an output for the year ended Sept. 30th, of 707,211,000 cubic feet, the illuminating value of which averaged 20.90 candles. The number of meters in use is 24,257—a gain for the year of 1,306. The receipts were $628,416.03, and the expenditures were $373,547.52, which sum does not include $170,000 paid in dividends. During the year 1,268 services were laid and 5 miles of mains were put down—the Company's main mileage now is 242½. The net gas rate remains at 90 cents per 1,000 cubic feet. The officers elected were: Directors, S. Alcorn, J. S. Blaikie, Henry Cawthra, G. R. R. Cockburn, Isaac C. Gilmor, George Gooderham, Jas. Henderson, Thos. Long, L. W. Smith, Frank Smith, A. J. Somerville and T. R Wood; President, L. W. Smith; Vice-President, Frank Smith; Secretary and General Manager, W. H. Pearson.——A correspondent forwards the following: "In the picturesque valley that lies between historic Look out Mountain and Missionary Ridge, about half way between the city of Chattanooga, Tenn., and the Chicamauga battlefield, is located a manufacturing plant of much interest to gas men. It is the only place in America where the lava tips, so much used by gas companies, are manufactured. It is only a few years ago that lava tips were entirely imported from France and Germany for American use; but in this industry, as in many others, America first equalled and later excelled all foreign competitors. The plant referred to is that of the D. M. Steward Mfg. Company, which enjoys a large share of the lava tip trading in this country and abroad. In closing it may be remarked that the making of these tips is not by any means a simple matter, for their completion means the ending of 11 distinct operations."

The Market for Gas Securities.

The market for city gas shares was very uneven during the week, Consolidated, on slight transactions, selling down to 184 and up to 187¾, which was really the range in the trading of to-day (Friday) up to noon. Standards are notably strong, the preferred being in demand at 150. The ludicrous war is still being waged, and the canvassers seem to be making the most out of it.

Brooklyn Union shows no particular change. Peoples, of Chicago, is at 106½; Baltimore Consolidated is 65½ to 66; and B. S. is 4, or thereabouts. The Jackson (Mich.) Company pays a dividend of 1½ per cent. the 1st prox.; and the St. Paul (Minn.) Company's dividend of 1 per cent. is payable to-morrow. We strongly advise the purchase of Consumers, of Jersey City.

[Abstract of Proceedings.—Continued from page 676.]

TWENTY-SIXTH ANNUAL MEETING, AMERICAN GAS LIGHT ASSOCIATION.

Held in the International Hotel, Niagara Falls, N.Y., October 19, 20 and 21, 1898.

Second Day, October 20, Morning Session.

Discussion on Mr. Rusby's Paper.[1]

The President invited Mr. Rollin Norris, of Philadelphia, to open the discussion on Mr. Rusby's paper. Mr. Norris then read the following comment:

Mr. Norris—In considering the question of deep versus shallow fires, it may be well to state briefly the general action of a water gas generator, and the ends for which we are striving. The object of the blasting is to store heat in the fire for the subsequent decomposition of steam, such storage of heat being effected by raising the temperature of the fuel bed. It is evident that, for the consumption of a unit weight of carbon during the blow, the heat absorbed by the fire is the difference betweeen the calorific value of carbon (say 14,500 heat units), and the sum of the heat carried off as sensible heat by the escaping products of combustion, and as potential heat in the shape of carbonic oxide. Anything that tends to reduce these last two items tends towards fuel economy. I assume we have plenty of heat for the subsequent fixing of the oil and that we are trying to store as large a proportion as possible of the heat of the carbon in the fuel bed. With a given blast pressure, the shallower the fuel bed the smaller the per cent. of carbonic oxide, and this makes for fuel economy; but, on the other hand, the shallow fuel bed does not allow time for the hot products to impart their heat to the fuel, and so the escaping products are hotter than with the deeper fire, and this makes for high fuel consumption. In other words, if we reduce the depth of the fuel we gain on the one hand but we lose on the other; and these two things tend to counterbalance each other. In Mr. Rusby's experiments it appears that the net fuel consumed per 1,000 is not affected very largely by the change in depth of the fuel bed. The two actions seemed to about counterbalance each other, the net fuel consumed being about the same with both depths of fire. But there was a marked advantage with the deeper fire, in greater capacity of set per hour and in reduced boiler fuel, due to the deeper fire decomposing a greater per cent. of the steam supplied to it. I spoke of the amount of heat stored in the fire being affected by the percentage of carbonic acid in the escaping products. It seems that the depth of the fuel bed has less effect on this than the question of the temperature of the fire. Mr. Rusby's analyses show that in the blast gas the carbonic acid was at the beginning of the blow as high as 18 per cent., and at the end of the blow it would drop to 7 or 10 per cent., and that not only were the products at the end of the blow going off at the higher temperature, but they were going off very much richer in carbonic oxide. If we could cut off the last minute of the blow we would apparently increase the proportion of heat stored in the fuel bed; but we really cannot do that because the high percentage of carbonic acid at the beginning of the blow is due to the low temperature of the fire, for if we attempt to reduce our final temperature we reduce the range within which we can run and so reduce the amount of steam decomposed. Quite a favorite prescription to save fuel is to cut off the last end of the blow; but it is difficult to do that because in shortening the blow we really are shortening at both ends. It is like the man with the potato patch who complained that the potato bugs ate up all the outside rows. He was told that the remedy was easy enough, "Don't plant any outside rows; plant all inside." We cannot do away with a last minute of blasting. As a matter perhaps of some general interest, and to get it on the record, I have here quite a number of analyses of blast gases, where the circumstances were entirely different from those of Mr. Rusby. The blast pressure under the grate was only 4 inches, consequently the fuel head was very low—fuel, gas coke. The following analyses will give some idea of the minute to minute variation in the quality of blast gases. The CO was not determined in each case, but it is practically a function of the amount of CO_2. The figures in any one vertical column were of samples collected during the same blow:

CO_2 in Generator Blast Gases: 6-Foot Generator.

2d min.	11.0	12 6	10.6	18.0	13.6	18.2	15.1	16.4
3d "	....	11.0	9.0	13.6	....	....	....	....
4th "	6.8	....	....	....	....	....	....	....
7th "	6.4	4 8	5.0	....	7.6	9.2	7.2	8.0

1. For text of paper, see Journal, *ante*, p. 675.

In the case of the last four samples in the above table the CO was determined with the following result:

Percentage of CO in Blast Gas.

2d minute	6.5	0.0	5.4	3.2
7th "	18 6	14.6	20.0	17.2

Mr. Rusby states that the percentage of acid in the gas decreases with the deeper fire; that is, there is a further decomposition of the carbonic acid as it passes up through the upper layers of the fire. This is rather a good point. It will be remembered that the London *Journal of Gas Lighting*, etc., published some years ago, a table giving the results of some experiments, by Dr. Bunte. The table showed that, for a certain temperature of the fire, there is a certain portion of carbonic acid formed which seems to be independent of the depth of the fire. I assume he means that in the presence of excess of steam the incandescent carbon seizes the steam rather than the carbonic acid, and increases the bulk of the gas produced rather than reduces the carbonic acid in the gas. This has been confirmed by some experiments made in analyzing water gas as produced in a Hanlon-Leadley set with three fires, where the gas passed down through two fires to the bottom of the third, and then up. The analyses showed that the per cent. of carbonic acid at the top of the third fire was practically the same as at the bottom. In other words, passing through this third fire did not reduce the percentage of carbonic acid present.

The President inquired if Mr. A. S. Miller would give his views on the subject.

Mr. Miller said he had some experiments made to determine how his results would check with Mr. Rusby's. In operating a water gas set an almost infinite number of conditions, such as blast pressure, amount of steam, depth of fire, etc., were encountered and had to be considered. Accordingly only by a long series of tests can we arrive at even approximate conclusions, and our results in these experiments were only approximate. The latter, however, closely sustain the experiments reported by Mr. Rusby. Assuming that all the work was done in the fire within 3 feet of the grate, and that all of the coal thrown in above was merely used to hold heat that would otherwise be wasted, we found a saving of heat equal to that claimed by Mr. Rusby. This was to say, the equivalent heat of from 1½ to 2 pounds of carbon was stored in the coal above the 3 feet to bring it to the temperature of the fire, assuming the fire to be at 1,800°. An interesting point brought out by Mr. Rusby was disregarding the conditions of the carbureter and superheater, when running his fire at a very low temperature, there was noted an enormous reduction in coal consumed. That matter had been forcibly brought to his attention when checking up the actual operation of independent cupolas as compared with double superheater apparatus. He found that the former could be operated on from 3 to 5 pounds less per 1,000 cubic feet of finished gas than the latter. At first he thought something was radically wrong in the operation of the double superheater apparatus, but subsequently by experimentation and deduction he determined that running the fire at such a low temperature that it would serve to convert the steam into water gas was very much more economical than running the fire at a high temperature and allowing the water gas to leave the fire at a high temperature. He had not figured to determine whether the sensible heat of the blast gases and the water gas on leaving the generator fire was sufficient to account for this difference; but the fact that that was about the only way the sensible heat could derive a percentage of the carbonic oxide in the blast gas between the low fire and the deep fire must of course account for the difference.

Mr. A. C. Humphreys asked if Mr. Miller would explain what he meant by a seperate generator?

Mr. Miller replied that he meant a generator from which the blast gas goes into the air and is wasted.

Mr. Norris said that as the actual fuel required in blasting, was 2½ pounds, the difference as between a deep fire and a shallow one certainly was not serious.

Mr. Egner said that the question which was before them had been fully solved in Germany by Herr Dellwick, who obtained the useful effects of a shallow fire and of a deep one at the same time by pas-ing air into the generator at different heights above the grate. In such use he was able to make short blasts and to save fuel, at the same time getting the heat necessary to decompose the steam in the upper part of generator. He mentioned that as worthy the attention of users of water gas apparatus, and from some experiments made by him in that line years ago he had no doubt that the Dellwick plan was sound.

Mr. Glasgow said that he had been unable to discover that Herr Dellwick's ideas are in advance of the common knowledge in water gas operations in this country. He spoke with positiveness about that, because of the recent attention he had given the matter.

Mr. Egner said he declined to withdraw his remarks about the utility of admitting air in the way described.

Mr. Glasgow said that the latest Dellwick patent application contained a single claim, which read about like this: "I have invented, and claim as new, a method of producing gas, consisting of so adjusting the depth of generator fuel and the strength of blast that the products of combustion issuing from the generator during the blast shall contain more carbonic acid than carbonic oxide."

Mr. Searle said he had spent about five months on the operating floor, in which time he gained an interesting experience respecting the use of coke in regenerator fire depths. He found an advantage in running the fires between 3 and 4 feet deep, with very high blast and pressure, in the attempt to accomplish what Mr. Dellwick claimed as new. In regenerating fire depths of anthracite coal they should remember that in blasting the fire they were certainly bringing the coal to combustion when they brought the air through the fire and having surface contact with it. The carbon was then coated with a filament of ash, and the depth of the fire would increase the depth of the incandescent carbon, but not sufficient carbon to decompose the water; but if they could blast sharp and speedy for 10 to 12 minutes, heating the carbon to a depth of 26 or 30 inches, they could blow off the particles of ash formed on the carbon surface, a point which he thought was interesting enough for consideration.

The Secretary read this written contribution to the discussion, contributed by Mr. Francis Carroll, Engineer of the New Orleans (La.) Gas Light Company:

I have made many analyses of the blue gas from our generators and invariably found, if they were cleaned with a 36-inch bed of fuel, as good a gas and as much as with a 6-foot bed—the same results exactly from a generator furnace in coal gas benches, with fuel bed reduced from 3 feet 6 inches to 1 foot 6 inches; but there was too much danger in working the low fuel bed. In testing the blue gas quantity and quality were taken on each one. The old Springer apparatus (Chicago), with a 3-foot bed of fuel, gave good gas; but I do not know of its economy in working.

The Secretary then said: On his own account, and following out Mr. Miller's parallel, as to the separate and combined generator, carbureter and superheater, that the separate method always appealed to his lazy side, in that it seemed it was much easier to cause the outside fire to fix the oil than to depend for that duty upon the carbureter and superheater. It required much less watching. He had always been hoping that some one would discover a scheme by which it could be done as cheaply as the other way, even if he had to give up the advantage of extra manufacturing capacity. He regretted to hear what Mr. Glasgow had said about the Dellwick process, for he had rather built a house of hope thereon. It seemed to him there was much less danger from loss by sensible heat escaping than from permitting the unconsumed carbon to escape. One had to increase the sensible heat so much before one could get the requisite number of heat units, in comparison with the latent heat lost in unconsumed carbon, that it seemed better to let the sensible heat go than to let the carbon go, for saving the carbon by increasing the sensible heat did not make very much difference. If one were so situated that he could get the weight of the escaping gases from the separate generator, figuring the exact amount of caloric carried out in the sensible heat, at the same time figuring the latent heat in the carbon (wasted in the ordinary process of blasting) and comparing the two, one could see right where he stood. Perhaps they could then determine whether it was worth while to consume the heat in blasting the carbon, rather than by putting in extra fuel to do the work of gasifying the oil.

Mr. Searle said he spent about a year in separate generator work, and could tell Mr. Forstall that was not the lazy side of the business, in that it required about 10 times the attention that a double superheater did, without being nearly as efficient or as economical for superheater purposes. There is no basis of comparison.

Mr. Egner said that what Mr. Glasgow remarked respecting the Dellwick specification might be interpreted in another way. Mr. Dellwick wished to impress the German engineers that he was not wasting any fuel. He knew the latter believed that ordinary water gas apparatus wasted much fuel through making carbonide oxide which was burned in the superheater, and largely superheated beyond the requirements. He wanted to impress them that, as in his apparatus the carbonic acid predominated, there was no such waste. Anyone having a water gas apparatus could easily apply the airblast at different levels, and he thought they would be benefited by the experiment.

The Secretary called attention to the fact that the personal equation would show itself in any and all results obtained. Mr. Searle had worked both the separate and the combined generator; so had the speaker. He hoped both were reliable, yet each had arrived at totally different conclusions. He was willing to acknowledge that the combined process apparatus with which he worked was a rather primitive one, yet three years' working of the combined process, and seven years' working with the separate process, had given in his case conclusions exactly the opposite of those reached by Mr. Searle.

Mr. Rusby, replying, said, as Mr. Norris had pointed out, the effect of shortening the blow for one minute was not what one at first sight thought it would be. There was a tendency to cut the blow at both ends. What one could do, though, was, by lessening continually the short blow, to secure the assimilation of heat in the generator. If the limit were fixed by the necessary decomposition of the water, the average temperature would go down continually, and with that the efficiency of the absorption of heat, or of the products of combustion in giving off the heat and making water gas. He had not read up very thoroughly the Dellwick system, but he noticed the inventor emphasized in his articles the great improvement he had effected over other engineers in the making of plain water gas, and that simultaneously with the use of his improved apparatus he shortened his blast considerably indeed. Dellwick quoted other engineers as having run from 7 to 8 months, blowing for that length of time with deep fires. Those who do that could only make carbonic oxide; in fact carbonic oxide would be largely in excess evidence. Whatever improved results Dellwick obtained were secured by shortening the blow. He thought Mr. Searle was using gas-house coke, and would suggest that gas-house coke was a much poorer conductor of heat, on account of its porosity, than an thracite coal. The probability was that, were an anthracite and a coke fire blasted for the like length of time, they would find the temperature of the coke very much higher than that of anthracite coal. The heat was carried into the interior of the fuel, thus raising its internal temperature, and it was the high temperature that determined the production of carbonic oxide. In the paper he referred to the fact that when he blasted his generator the fire had attained a very high temperature, and that a large quantity of carbonic oxide was formed right at the moment of combustion down to 2 feet above the grate. If a coke fire got very hot on the surface the production of carbonic oxide would be very heavy, in which case all one had to do with the deep fire was to cut the length of blast to perhaps three-quarters of a minute. Then one would limit the heat stored in the fore part of the blow, so that the run could be correspondingly shortened. Probably Mr. Searle had done the only thing possible in his case, which was to diminish the depth of his fuel bed.

Mr. Searle said he must speak only with regard to his practice, which led him to assert that they had determined the period which gave them the best conditions under which they had worked. Their men said they had a superior "gas-house" coke, and during the 5-minute blow they had more carbonic oxide than they could dispose of. They had selected the depth of fire and length of blast best suited to their conditions. They were operating under 2-minute blows and 5-minute runs. When they arrived at the point yielding about the oxidation needed in the superheater they stopped, and so the depth of fire was regulated to obtain that result. Respecting separate generator and separate bench practice, the thing that would most distract the operator was the efficiency.

The Secretary declared that he had said nothing about efficiency, but that it appealed to his lazy side. He hoped, however, there would be some way or other of getting at the efficiency.

Mr. Searle inferred from what the Secretary said about his "lazy side" that there was too much work about it to get at that point.

Mr. Miller thought the subject introduced by the Secretary was not exactly germane to the paper, and he would suggest that at the time spoken of by him (7 years ago) the conditions of working, and the skill in operating as well, differed much from those now existing.

On motion of Mr. A. C. Humphreys, a vote of thanks was passed to Mr. Rusby.

The President introduced Mr. Walton Forstall, of Philadelphia, who read the following

NOTES ON MAINS AND MAIN LAYING.

Weight of Pipe.—In 1892 a standard weight for gas mains was adopted by the Society of Gas Lighting. Since that time the constantly growing difficulty of obtaining proper cover in large cities, combined with the decrease in the cost of iron, have operated towards increasing the weights of the smaller sizes, so that no matter where a pipe is placed it will be strong enough to stand the shock of street traffic, the idea being that instead of using the Society's standard for the general run of work for which it is amply strong, and using heavier pipe for the exceptional locations that are constantly on the increase in cities, it is practically as cheap, and much more convenient, to have only one weight which will serve for all cases. And the reason for increased weight is the use of larger services, necessitating increased thickness of mains to give a sufficient number of threads in the service hole; and this has had much to do with fixing the weight of 4-inch and 6-inch in recent practice.

Below is the Society standard, compared with recent practice:

Size,	Weight per Length. Society of Gas Lighting.	New York City. 1894.	Philadelphia. 1898.
4 inch.....	208	216	228
6 "	306	360	360
8 "	471	504	492
12 "	905	864	852
16 "	1,326	1,344	1,320
20 "	1,998	1,776	1,920
24 "	2,382	2,400	2,640
30 "	3,472	3,240	3,480

The difference in the case of 6-inch is quite marked, but the cost of increased weight is a comparatively slight percentage (about 5 per cent.) of the total labor and material cost, and should be considered a low premium for the insurance it affords of freedom from breaks even under trying conditions.[1]

Methods of Connecting Services or New Mains to Existing Mains.—This applies to the many cases where the outlets of existing mains are too small, or are not in the place desired, and new connections become necessary. One and one-quarter inch is the smallest service run, and all services, to 4-inch inclusive, are wrought iron. Any larger service would be cast iron and treated as a main. For all services a full size hole is tapped, except as now noted. A 1¼-inch in a 3-inch or 4-inch main would have a ¾-inch or 1 inch hole respectively, the enlargement being made in the street ells. A 1½-inch service would be connected to a 3-inch or 4-inch main by a split sleeve tapped for a 1½-inch or 2-inch hole, respectively. A 2-inch service from the same size mains would be connected by the same split sleeves as the 1½-inch service, this being done to prevent an excessive variety of specials. A 2-inch service from a 6-inch main would be supplied from a 1½-inch hole. A 2½-inch service from a 3-inch main would be supplied from a 4-inch by 4-inch tee. This involves a good deal of bushing, but is adopted because no more 3-inch mains will be laid, and the replacement of present ones is but a matter of a few years, so it is not considered advisable to buy any more 3-inch branches. A 2½-inch service from a 4-inch or 6-inch main would be fed by a split sleeve tapped by a 2-inch or 3-inch hole, respectively, from an 8-inch main by a 2 inch hole tapped in the main. A 3-inch service from a 3-inch or 4-inch main would be supplied by a 4 inch by 4-inch tee, from a 6-inch or 8 inch main, by a split sleeve with a 3 inch hole, from a 12-inch main by a 2½-inch hole tapped in the main. A 4-inch service from a 4-inch main by a 4-inch by 4-inch tee, from a 6-inch or 8-inch main by a 6-inch by 6-inch or 8-inch by 6-inch tee, as no more branches with 4-inch arms will be bought, there being little 4-inch main contemplated in future extensions. From a 12 inch and a 16-inch main a split sleeve tapped for 4-inch would be used.

In connecting mains to mains, the idea is to use a saddle piece, otherwise called a hat flange, wherever the disparity between the two mains is very great, and the largest so large that a split sleeve with hub cast on would involve heavy cost. As the disparity and the size of the largest main decrease, split sleeves are used, and then in turn ordinary branches.

A 4-inch main would connect by saddle pieces to 20-inch and over, by branch with 6-inch arm to 16-inch and under, except to 4 inch, where 4-inch arm would be used. A 6-inch main would connect to 30-inch and 24-inch by saddle pieces to 20 inch by split sleeve; to 16-inch and under by tee or cross. For an 8-inch the same rule would be followed. There might be cases in which a 6-inch or 8-inch was to be connected to a 16-inch, where local conditions would render a split sleeve preferable to cutting the main and inserting a branch; all mains of 12-inch and over to be connected by cutting out and inserting the proper special.

Below is given in tabular form the scheme of connections just described. The idea is to have a standard system, so that the necessary

1. Since this was written, the Society has adopted a standard, and is now practically in line with recent practice.

specials can always be kept in stock ; and in order that the variety of these shall not be excessive, several are made to serve for more than one connection.

Services to Existing Mains.

Size of Services.	Size of Main.								
	30 in.	24 in.	20 in.	16 in	12 in.	8 in.	6 in.	4 in.	3 in.
Inch	Hole. Inch	Hole. Inch	Hole. Inch	Hole. Inch	Hole. Inch	Hole. Inch	Hole. Inch	Hole. Inch	Hole. Inch
1¼	1¼	1¼	1¼	1¼	1¼	1¼	1¼	1	¾
1½	1½	1½	1½	1½	1½	1½	1½	Split sleeve 2 in. hole.	Split sleeve 1½ in. h.
2	2	2	2	2	2	2	1½		
2½	2½	2½	2½	2½	2½	2	Split sleeve 3 in. hole		4×4 Tee
3	3	3	3	3	2½	Split sleeve 3 in. hole.		4×4 Tee.	
4	4	4	4	Split sleeve 4 in. hole.		8 x 6 Tee	6 x 6 Tee		

For drawing and table of dimensions of service sleeves, see Appendix to paper.

New Mains to Existing Mains

Size of New Mains.	Size of Existing Mains.							
	30 in.	24 in.	20 in.	16 in.	12 in.	8 in.	6 in.	4 in.
4 inch	Saddle Piece or Hat Flange.	Saddle Piece.	Saddle Piece. Split Sleeve.	Insert Branch.	Insert Branch.	Insert Branch.	Insert Branch.	Insert Branch.
6 inch	"	"	"	"	"	"	"	
8 inch	"	"	"	"	"	"		
12 inch	Insert Branch.	Insert Branch.	Insert Branch.	"	"			
16 inch	"	"	"	"				
20 inch	"	"	"					
24 inch	"	"						
30 inch	"							

For drawings and tables of dimensions of hat flanges and hub sleeves, see Appendix to paper.

Methods of Main Laying—Contract and Otherwise.—When main extensions are made slowly, year by year, it is probable that most superintendents are both able and willing to do the work themselves, but if in any one season there are many miles of small size, or a few miles of large size, to be put down, the temptation is great to let the work to a contractor, as it is often very hard to so expand the regular force as to care for this extra work speedily and well. If the ditching only is let out the superintendent still has in his own hands the most important part of the job, from the leakage standpoint, and ought to feel sure of the tightness of his own work ; but in all contracts of this kind involving divided responsibility, the division line must be clearly drawn, so that in case of accidents from open ditches the blame can be rightly placed. Contractors have been known to claim that where a ditch was ready for pipe on Friday noon, failure to lay this in the afternoon, so that backfilling could be done the next morning, rendered the company liable for an accident caused by the open ditch on Saturday night. In another instance, where one contractor opened the trench and removed surplus dirt after paving was complete, he claimed his responsibility ceased the moment the trench was bottomed and did not begin again until the paving contract (who did the refilling gratis in order to be sure of his paving) was through, and the surplus dirt ready for removal. As this point had been provided for in the specifications, the company could not be held for the two accidents, the liability for which the contractor tried to fasten on them by this plea.

When it is deemed advisable to let the entire job by contract, a test under air pressure of, say, 2 pounds is of great value, if only because of its moral effect on the contractor's men. It is possible to have a line tight under this pressure and yet for the caulking to be so poorly done that leaks develop in one winter ; but an adequate number of capable inspectors will insure such personal acquaintance with the caulkers, that any unskillful or dishonest ones can soon be detected, especially in connection with the air test where every joint is gone over with soap and water by the inspectors, and any caulker whose work shows leaks is warned. In this way, either on contract work or where the company is doing a large job with many new men, it takes but a short time to weed out the bad caulkers. By observations of a mercury gauge the superintendent can assure himself of the tightness of the work, independently of the inspectors' reports, and no drop in pressure should be allowed. Air is preferable to gas solely because of the higher pressure obtainable.

Outside of the necessity for greater vigilance in order to obtain tight joints where contracts are let, there is the serious disadvantage, especially in large cities, of the indifference to the comfort of the the public that is so often characteristic of contractors. Their sole idea is profit, and too often this is very small, for the bid has been made with great optimism, trusting that the company would not allow them to lose money on the job. So they let the surplus dirt pile up until it accumulates in sufficient quantity for most economical handling ; they block up streets because they are too poor to buy lumber for sufficient bridges, etc. If such things are permitted the money value of the public favor lost by the company will much overbalance any possible saving on the contract. It certainly pays to see that all work is done with the least possible annoyance to the public, and where loosely drawn specifications allow the contractor to save money in this way, the city authorities being indifferent, the company should, at its own expense, remedy matters, and drop that contractor forever. As an example of how tightly it was necessary to bind some contractors, I append a set of specifications used for about 80 miles of pipe in a large city, all the work being done by contract. (See Appendix to paper.)

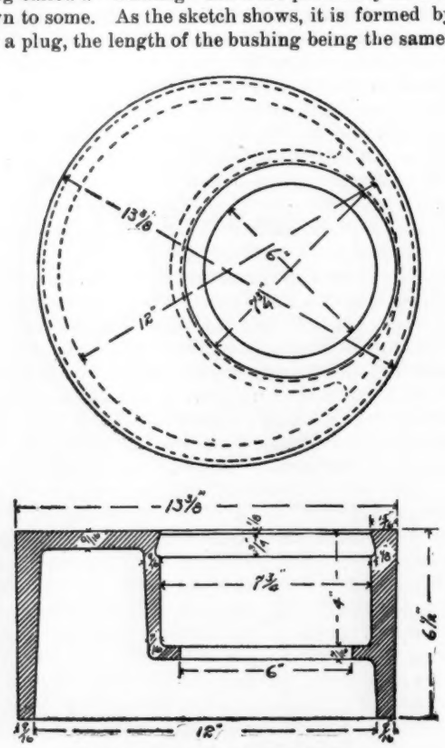
The being able to have direct control of all details of work, where there is contact with the general public, is the strongest reason in my mind why a company should do all its own work ; and fortunate the superintendent in charge of a company large enough to demand such a permanent force that it can serve as an efficient skeleton for any enlargement needed for great main extensions. The chief consideration in this case of company work is that of cost, for the question of excellence ought to be settled by the character of the permanent employees. There is danger that the company's foreman, accustomed to small jobs, often involving a certain amount of time to be "filled in," will be satisfied with a good deal less than an attainable day's work. Foremen habitually employed by contractors, whose rating depends directly upon their reputation for getting so much ditch dug or pipe laid per laborer per day, have the right idea from the cost side at least. To impress this same idea upon permanent employees, nothing else is so helpful as to keep close oversight of costs by a daily record both of labor and material for all large jobs, and weekly, fortnightly or, at the longest, monthly records for small jobs. Two forms of such records accompany this paper (see Appendix) and have been found the means of imparting to the whole supervising force a realization of the value of each laborer's work, and of the fact that their own worth to the company depended largely upon the figure at which they could keep the cost per foot of pipe laid. The men in charge of our large jobs, being college graduates, know enough arithmetic to realize that, for a small quotient, a small dividend and a large divisor are necessary, and this knowledge makes them bend every effort to keep ditch ready for the derrick gang. In big cities, this often means getting out the laborers at 5 A.M. to open trench, that because of city conditions could not be dug the night before. Without the pressure of the daily cost report, the average foreman would not be alive to such necessity for extra working, and such men are the ones oftenest dealt with.

Where long lines of large pipe are to be laid and work has been begun at the cheapest end, it is interesting to watch the keen endeavor to keep down the increase in cost that naturally comes as more expensive conditions are encountered. This struggle is excellent training for every one on the job, and is brought about with very little effort, for the figures for cost of labor and quantities of materials used each day are the only ones supplied by the timekeeper, all additions for totals and cost of materials being worked out in the office by the stenographer. For convenience material is reported as *received* on the work, rather than as *used*.

Specials.—It is generally agreed that a large proportion of tees and crosses should be made with all hub ends. In this way less pipe is left for the scrap pile, as at almost every intersection a spigot piece can be used in connection with an all hub special, and it is common experience that spigot pieces will accumulate faster than opportunities for their use solely in closing gaps with sleeves. Again, on paper you are often advised to have all branches made with bottom outlets, so that if desirable a large pipe can drain into a small one. These eccentric outlets also give a very desirable latitude in the placing of branches in a way similar to the bushings referred to later. These several facts, however, seem to be among those that people hear and then forget, for the all-hub branches with eccentric outlets are too seldom met with in gas practice. Where sewer or electrical manholes must be gone around, bends with two hubs make less detour necessary, as they can be laid snug against the obstruction, the caulking being all towards the latter.

Offset pieces are not of much use in very crowded streets, as the necessary offset is seldom that of any fitting kept in stock. By using two bends and cutting one to measure any offset can be obtained.

The fitting called a "bushing" has a use peculiarly its own, and may be unknown to some. As the sketch shows, it is formed by casting a hub *inside* a plug, the length of the bushing being the same as the simple plug. Bushings have been made by casting a hub *upon* a plug, the length being that of the two combined; but such a fitting does not meet the conditions for which the real bushing is designed, as now note. Large mains should be provided with outlets of generous dimensions, this being the safest practice. Suppose a 20-inch main, with a 20-inch by 12-inch tee, placed in the most available position at a street intersection, yet with a 6-inch water pipe running parallel with the 20 inch, and so close to it that a 12-inch pipe could not be laid from the tee. Of course, if it was absolutely necessary to lay a 12-inch there, an attempt would be made to have the water pipe moved; but, as it happens, when there is need for a main in that street a 6-inch is considered large enough. The water pipe prevents the use of a reducer, but the 12 inch to 6 inch bushing takes no more room than the 12-inch plug, and the 6-inch hub being cast *eccentric* in the plug, allows a position that will clear the water pipe.



12 Inches by 6 Feet Bushing.

Records.—Every year increases the number of those using the card system for recording data, and where there is a large mileage, whose *exact* location is unknown, no better way exists of gradually collecting the desired information in shape for instant reference, than by service cards and street information cards, the former showing the main locations at every service and the latter those at any other openings. Both sets of cards being filed geographically, it takes just two looks to settle whether anything is known of the mains at the desired point. By transferring the main locations from the service cards to street information cards, all main data can be filed in one place; but the advantage thus gained is seldom worth the work necessary.

The recording of new mains is a problem of almost as many solutions as there are solvers. With practical agreement upon the necessity for exact knowledge of location of all specials and bells, of curb distance, and, in minor degree, of depth, there are many ways graphical or descriptive, or graphical and descriptive, of showing these. Some have sketches of specials only, which practically means all intersections, contenting themselves with a written record of intervening straight pipe. These sketches, entirely devoid of scale, are on cards conveniently ruled and are generally filed geographically, the method being well adapted to main laying done by the company's employees, where usually the foreman, to whose lot the record taking falls, is just skillful enough to make these sketches, especially when aided by rubber stamps representing all styles of specials.

It was the writer's good fortune to lay the first mile of a distribution system and to work out the recording of 80 miles on a definite plan, conceived by his superior, so that at the end every foot was shown on sketches and could be referred to in an instant. The unit was a city block, each with its own serial number shown on a key map of the city, and sketches were filed by number in batches of 100. Each gave the main in plan and elevation, also curb elevations above mean high water, and the location of solid rock encountered. The original drawings were made on thin bond paper, blue prints from which formed the working file, the originals being preserved in fireproof quarters. As every new line was planned, numbers were assigned to each block, and a survey made of the ground to obtain curb elevations and distances from a fixed zero point. Field books were filled out with this information, the exact limit of each block sketch was decided on, and thereafter, in all records and reports, the block number governed. All work was by contract, and detailed record of earth and rock excavation as well as feet of pipe laid was necessary, but by use of the block number work could be reported each day from any number of places without confusion arising, and at the end of the job the record of costs under each number could be found and set down on the proper sketch, so that the maps showed costs as well as locations.

The maps were in use day after day and proved their great convenience for the conditions they were designed to meet. The company being a new one, could not possess the old service foreman who carries all main locations in his head. A main laid this week by the contractor would next week be tapped by the company's service gangs, who had not the slightest idea of its location, and recently restored pavement was not a reliable clue, as there are openings galore in the streets of that city, and your main is probably hard against that of a competitor, so that exact depths and curb distances are essential to the service foreman. These were provided for him in this case by making rough, freehand sketches from the working files, and carbon paper enabled three of these to be made at once. One was sent out with the service orders for that block, and came back when the work was done, to be filed with the other two which were to take its place when it wore out. These rough sketches were filed according to numbers, exactly as were the blue prints, and when a request came for maps of such and such blocks it was quickly seen whether the sketches were there, and if not, some were made; and thus day after day the file of rough sketches increased until it was complete.

This was a system made possible by peculiar conditions, and worked out by a staff composed entirely of college men, and under similar circumstances elsewhere its value would again be shown.

A Connection "Wrinkle."—Given a 36-inch by 36 inch cross in the line of the only supply main to a city, from which the gas cannot be shut off, thus preventing the use of bags in the main, and making impossible the removal of the 36-inch plug from the arm of the cross, how is a 24-inch main to be connected to this plug through a full sized opening?

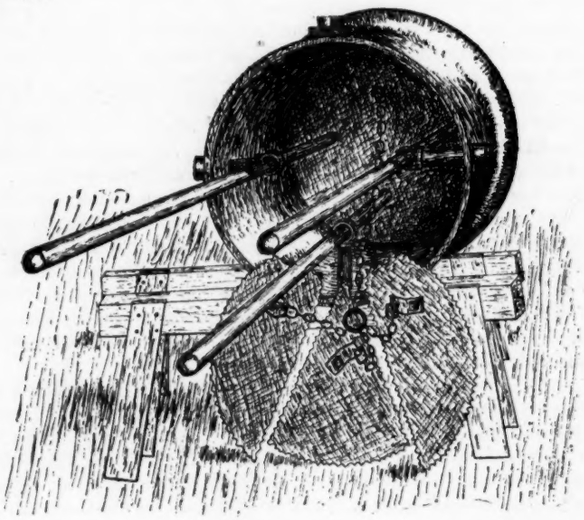


Figure 1.

The writer made four such connections, using the apparatus, a piece of 24-inch pipe arranged as hereafter described, shown in perspective in Fig. 1. Fig. 2 is a longitudinal section showing everything in readiness to make the opening in the 36-inch plug. Fig. 3 shows the plug,

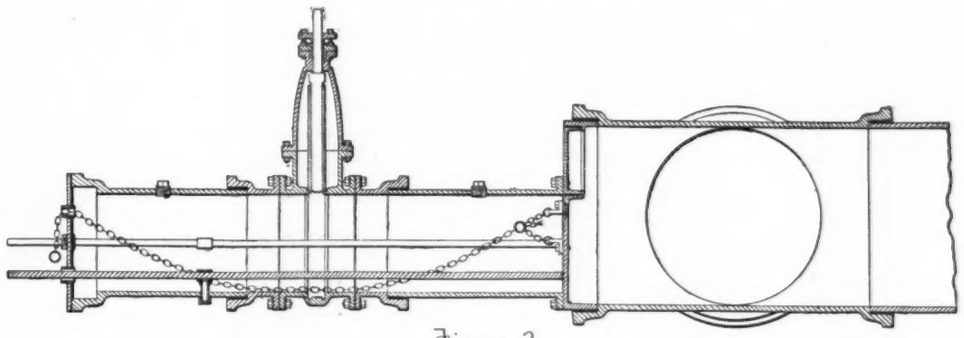


Figure 2

as drilled previous to tap bolting on a 24-inch flange piece, the outer row of holes being those for the bolts. The inner row and the two lines dividing the inner circle into three segments are holes drilled as close together as was deemed safe, leaving just enough iron to hold the pieces in place. The full 24-inch circle could not be made, because the 36-inch plug was really a 36 inch by 12-inch bushing, and the 12-inch bell, which it was desired to leave intact, cut across the 24-inch circumference. As part of the 24-inch flange came upon the 12 inch plug, it was necessary in each case to remove the original plug and substitute one of such length that it was flush with the face of the 36-inch plug. The drilling of the holes being finished, the flange piece, 3 feet in length, was secured to the plug, a 24-inch valve was placed in line, and to this was connected with a temporary joint the special piece of 24-inch pipe, also about 3 feet long, prepared for this occasion and shown in Fig. 1. Its working (bell) end was closed by a plate of wrought iron clamped on a rubber gasket upon the face of the bell. This plate was pierced by four holes, through one of which passed a single chain, uniting three that were attached, one to each segment of the inner circle. Through the other three holes passed iron rods guided through 1¼-inch pipe so arranged that each rod centered on a segment.

When everything was ready, the rods were shoved forward against the segments and struck with a sledge. This quickly knocked the segments loose and they were drawn by the chain through the flange piece and past tne valve, and the latter then shut down. In this way two of the connections were made. Another was slightly easier, for circumstances favored bolting the valve directly to the 36-inch plug, so

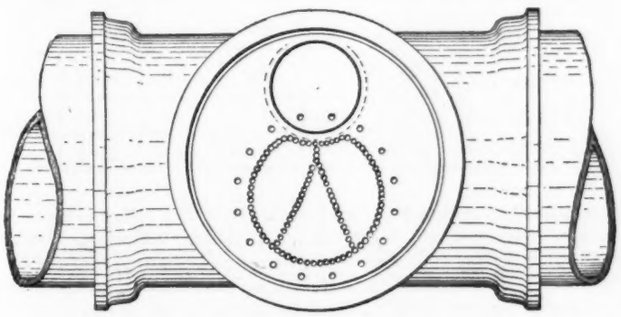


Fig. 3.

that there was only a short journey for the segments. The fourth connection was the hardest, for the valve could not be placed within 20 feet of the cross. In this case, after the segments had been pulled through the flange piece into the temporary piece, a 24 inch bag was placed in the former, a 36 inch bag in the arm of the cross, the temporary piece was removed, and the line continued with more or less trepidation until the valve was set.

In almost every case the segments gave way at the first blows on the rods, and in this respect, and in the ease with which the pieces were dragged out, even across the valve, the work afforded pleasant surprises. To protect the valve seats a piece of tin was used and afterwards fished out. Crude stuffing-box arrangements prevented any escape of gas from the holes around the rods or chains. The men suffered only while drilling the many holes in the plug.

Appendix.

Specification for Laying Gas Mains in the City of——.

Location and Conditions.—The gas company, after determining upon the probable location for its mains in the various streets, avenue and public places in the city of——, will inform the contractor or his agent as to such location and the size of main to be laid therein. The contractor or his agent is then to make investigation of the conditions to be found in the given location, and is to base his prices upon such investigation, and upon the requirements of this specification.

No claims for extra payment on account of any work done under contract made between the gas company and contractor, based upon this specification, location given and prices named, shall at any time be entered or considered.

Such work not covered by contract as may be required to be done shall be executed by contractor, *only*, on instructions given by written memoranda, over the signature of the engineer of the gas company, or such officer as may be appointed to represent said engineer, and at a price to be agreed between the parties, prior to the execution of said work.

Direction.—All work shall be executed under the direction and to the satisfaction of the engineer of the——gas company, or such officer or employee as may be appointed to represent said engineer, and in strict accordance with the ordinances, extant or hereafter instituted, of any of the city departments of the city of——. In the event of any discussion arising as to the signification of any portion of this specification, or as to the best method of executing any portion of the work, the judgment and decision of the engineer of the gas company shall be final, and shall be so accepted by the contractor.

Salaries of Inspectors.—Any costs for inspection imposed by any of the city departments, city of——, upon the work to be executed, being executed or after execution by any contractor, shall be charged to said contractor, and entered against him on account of the contract for said work.

Changes.—Changes made at any time or for any reason in the exact location between the building lines of any street, avenue or public place, or in the depth below the pavement or surface of ground of any main, shall in no wise invalidate contract, nor justify any claims for extra payment.

Alterations in Existing Mains and Services.—Whenever it may be necessary to alter or replace any existing main or service or portion of any main or service of any other company or corporation, whether supplying gas, water, steam, electricity or any other commodity, or any sewer or connection to sewer, same shall be executed under direction of the engineer of the gas company by the contractor and at the contractor's own expense; but whenever such work may be done only by such other company or corporation, the same shall be executed under the direction of the engineer of the gas company, who shall certify to the correctness of the charge for same, a copy of which shall be sent to the contractor immediately upon its receipt by the gas company and the gas company shall have the right to pay such charge within ten (10) days thereafter, and to charge same against the contractor's account, and deduct the same from any moneys due or to become due to him hereunder.

Materials, Labor and Tools.—All mains, pipe and specials shall be of cast iron. All castings of every description shall be furnished by the gas company to the contractor at one of the storage yards of the gas company in the city of ——, or ex-boat, or on dock, in the city of ——, as delivered by maker. All other material necessary for the proper construction of mains, including lumber for bridges and sheathing and protection of trenches, lead and yarn for making joints, and blocking on which to rest castings, shall be of the best quality used for the purpose, and shall be furnished by and at the expense of the contractor, subject to inspection and approval of the engineer of the gas company. Contractor shall furnish all labor and all tools necessary for the proper execution of the work covered by contract, and should any

employee of contractor seem to be executing his work in a careless or improper manner, or should he be conducting himself in a manner prejudicial to the interests of the gas company, in the estimation of the engineer of the gas company, he shall be at once removed by contractor upon the direction of said engineer.

Distributing Pipe and Castings.—The contractor shall receive all pipe and special castings from the gas company at one of their storage

SERVICE SLEEVES

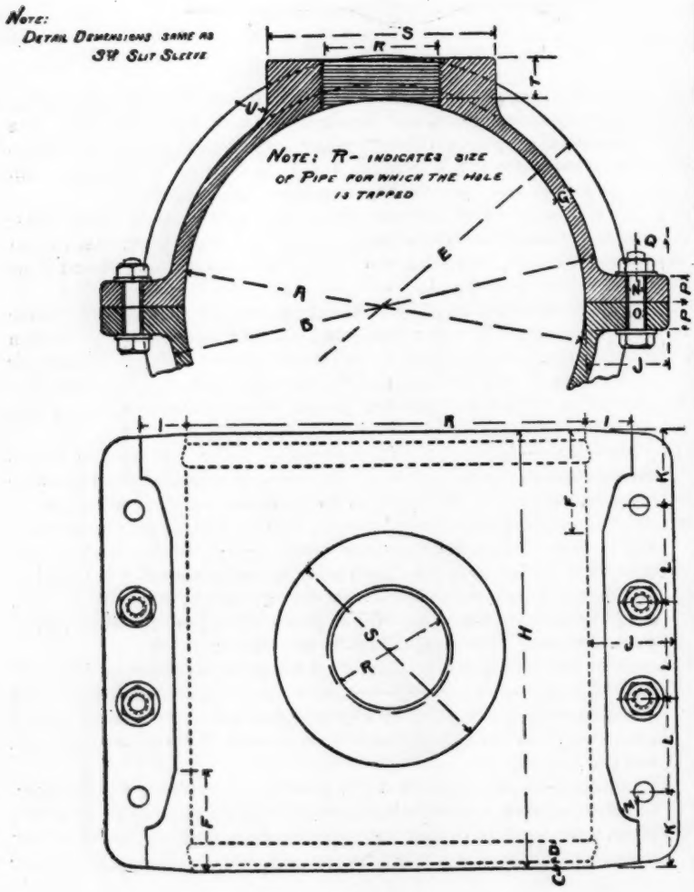


Table of Dimensions of Service Sleeves.

Size	3"	4"	6"	8"	12"	16"
A	4 5/8	5 5/8	7 3/4	9 3/4	14	18 1/4
B	5 3/8	6 3/8	8 5/8	10 5/8	15 1/8	19 1/2
C	1/4	1/4	1/4	1/4	1/4	1/4
D	3/4	3/4	3/4	3/4	3/4	1
E	6 7/8	8 1/8	10 1/4	12 3/4	17 1/4	21 3/4
F	3	3	3	3 1/2	3 1/2	4
G	3/8	3/8	7/16	7/16	9/16	5/8
H	15	15	15	15	15	18
I	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4
J	2 3/4	2 3/4	2 3/4	3	3	3 3/4
K	2 1/4	2 1/4	2 5/8	2 5/8	2 5/8	3 1/4
L	3 1/2	3 1/2	3 1/4	3 1/4	3 1/4	2 7/8
M	9/16	9/16	5/8	11/16	11/16	11/16
N	5/8	5/8	5/8	5/8	5/8	3/4
O	3/4	3/4	3/4	3/4	3/4	7/8
P	3/4	3/4	13/16	13/16	15/16	1 1/16
Q	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 5/16
R	1 1/2	2	3	3	4	4
S	3	4	6	6	8	8
T	7/8	1	1 3/8	1 3/8	1 1/2	1 1/2
U	15/16	1	1	1	1 1/16	1 1/16
Threads per inch in Boss	11 1/2	11 1/2	8	8	8	8
Weights: Minimum	43	65	95	120	187	296
Estimated	45	68	99	125	195	308
Maximum	47	71	103	130	203	320

yards, or at the dock city of ——, at which delivered by makers and shall be liable for any expense incurred by reason of delay in unloading boat; shall transport same at his own expense to and distribute along the street, avenue or public place in which to be laid. The contractor shall be responsible for and make good all loss by breakage, thieving, or other cause from the time pipe and special castings are delivered to him at any of the above localities until laid and covered in by backfilling of trench, as hereinafter described, or are returned to one of the storage yards of the gas company.

The contractor shall carefully examine each piece of pipe and special casting before receiving same from the gas company, in order to satisfy himself that the same is sound, and after having once accepted same shall claim no resource against the gas company for expense of distributing same, in case it be subsequently found defective.

Trenching.—The exact location of trench from curb line or other points shall be determined upon by sounding or digging test holes ahead of the trench, such sounding to extend sufficiently far in advance of the actual trenching, not to cause delay by reason of changes in line (hence in permits) made necessary by the precise conditions discovered by the test holes.

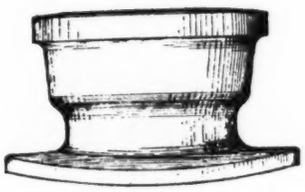
Sufficient pavement shall be taken up to permit the opening of trenches of proper width for the various sizes of pipe as given hereinafter; all paving to be carefully preserved and piled neatly along side of trench. Earth and other matter removed is to be neatly heaped so as to give least possible obstruction to teams and pedestrians.

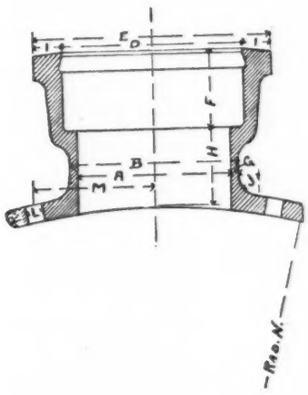
In cross streets, in addition to the bridges required by ordinances, a bridge shall be furnished across trench every 200 feet, so that proper access to foot walk will be given for vehicles. Trenches, wherever possible, shall be of sufficient depth, when in earth, to permit the body of pipe to lie directly on the undisturbed earth at bottom, and give three (3) feet of cover for pipe (*i.e.*, three feet from top of pipe to surface of pavement); bell holes shall be dug to give proper access to joints for caulking. In each hole back of the bell a block shall be placed resting upon undisturbed earth. This block shall be in length not more than 8 inches shorter than width of trench, not less than 6 inches wide, and of sufficient thickness to take bearing of pipe as above. Trenches, wherever possible, shall be of sufficient depth when in rock to leave a space of not less than 4 inches from bottom of pipe to highest projection of undetached rock in bottom of trench, and give 3 feet cover as above. Two blocks shall be furnished for each length of pipe to give a bearing from undisturbed rock; one shall be placed about 1 foot back of bell, the other about 4 feet from spigot end. These blocks shall be in length, not more than 8 inches shorter than width of trench, not less than 6 inches wide, and of sufficient thickness to raise pipe to proper grade.

Contractor will, whenever necessary, protect trenches by proper sheathing or other means, and will furnish adequate support, by proper shoring or chaining, for all pipes or other property, the safety of which may be endangered.

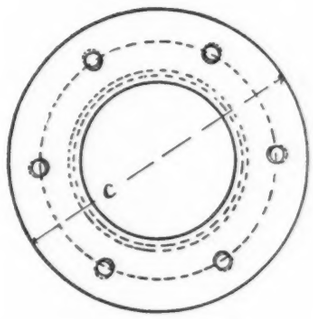
Laying Pipe and Specials.—The contractor shall carefully examine and clean each piece of pipe and special casting before placing in trench; any piece of pipe or special casting found cracked, broken or defective, must be laid one side subject to the inspection of the engineer of the gas

Hat Flange.



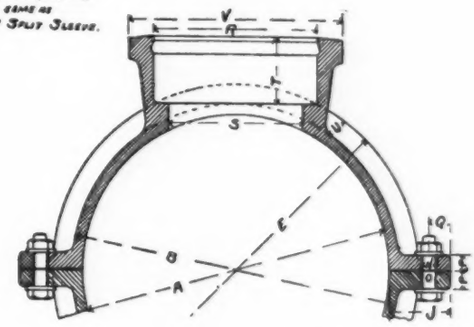


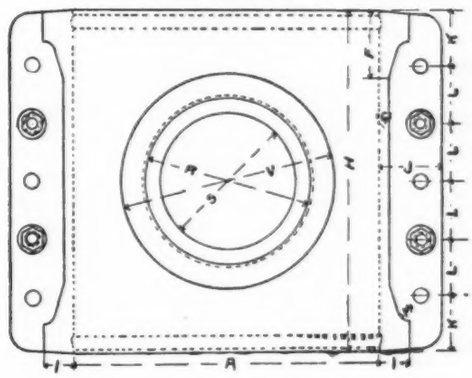
NOTE: DETAIL DIMENSIONS SAME AS STRAIGHT PIPE



HUB SLEEVE.

NOTE:
DETAILS FOR HUB - SAME AS 30" STRAIGHT PIPE
OTHER DETAILS SAME AS 30" SPLIT SLEEVE.





Dimensions of Hat Flanges.

Size	A	B	C	D	E	F	G	H	I	J	K	L	M	N	Weights. Minimum Estimated Maximum.
30" x 6"	6	6 7/8	13 5/8	7 3/4	10 1/2	4	7/16	4	1 3/8	1	7/8	7/8	5 5/16	16	67 70 73
30" x 8"	8	8 7/8	15 3/8	9 3/4	12 3/4	4	7/16	4	1 1/2	1	7/8	7/8	6 5/16	16	99 103 107

company. The pipe shall be so placed in trenches that the line be kept straight, and at an even gradient wherever possible, and with the distinguishing mark on upper side.

In every case pipe shall have positive bearing on blocks specified above in preparation of trench. Each spigot shall be set into bell with which it joints, so that no portion of the end of spigot lies nearer than ¼-inch, nor further away than 1¼ inches from bottom of bell, and so that the space from outer surface of spigot end to inner surface of bell be accurately equalized at every point of the circumference.

In the space formed as above strands of clean yarn shall be carefully rammed, until space is filled to give the lead depth required for the size of pipe, and sufficiently firm to cause the yarning tool to spring back when impinged against it.

For 4-inch diameter pipe, lead joint to be 1¼ inches deep.

"	6	"	"	"	"	1½ "
"	8	"	"	"	"	1¾ "
"	12	"	"	"	"	1¾ "
"	16	"	"	"	"	2 "
"	20	"	"	"	"	2¼ "
"	24	"	"	"	"	2¼ "
"	30	"	"	"	"	2⅓ "
"	36	"	"	"	"	2⅓ "

Dimensions of Hub Sleeves

Size	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	Weights. Minimum / Estimated / Maximum
16" × 6"	18 1/4	19 1/2	1/4	3/4	21 3/4	4	5/8	18	1 3/4	3 3/4	3 1/4	2 7/8	11/16	3/4	7/8	1 1/16	1 5/16	7 3/4	6	4	1	10 1/2	314 / 327 / 340
16" × 8"	18 1/4	19 1/2	1/4	3/4	21 3/4	4	5/8	18	1 3/4	3 3/4	3 1/4	2 7/8	11/16	3/4	7/8	1 1/16	1 5/16	9 3/4	8	4	1	12 3/4	324 / 337 / 350
20" × 6"	22 3/8	23 3/4	1/4	1	26 1/8	4	11/16	18	1 7/8	3 3/4	3 1/4	2 7/8	3/4	3/4	7/8	1 1/8	1 5/16	7 3/4	6	4	1	10 1/2	589 / 614 / 639
20" × 8"	22 3/8	23 3/4	1/4	1	26 1/8	4	11/16	18	1 7/8	3 3/4	3 1/4	2 7/8	3/4	3/4	7/8	1 1/8	1 5/16	9 3/4	8	4	1	12 3/4	601 / 626 / 651

In sleeves, or wherever else it may be considered necessary to increase these lead depths, same shall be done on instructions by the engineer of the gas company, without extra charge or allowance.

The "snake" or "clip" for holding lead in joint during pouring shall be so set that, after joint be poured and clip removed, the lead on its outer circumference shall be flush with face of bell, and on its inner circumference shall extend not less than ¼-inch beyond face of bell. This extension is to be carefully driven back into bell until caulking brings lead flush with face of bell at every point. Necessary lead for joint must in every case be supplied in one continuous pouring.

Drips.—Wherever it may be necessary to locate drips for proper drainage of the mains, the type, whether "line" or "side," will be determined by the engineer of the gas company. The necessary excavation and the setting of all castings and wrought iron fittings, and making of all joints, whether in castings or wrought iron fittings, shall be executed by the contractor. All castings and wrought iron pipe and fittings shall be furnished by the gas company. All material necessary for making joints as above shall be furnished by contractor.

Testing.—All mains shall be carefully tested for leakage by filling same with air under pressure before backfilling trenches. As far as possible the mains shall be laid in sections, permitting the use of hand pumps to supply the air under pressure for testing. For this purpose the contractor will supply himself with suitable pumps and necessary fittings. He will supply labor to operate pump in raising pressure to not less than 2 pounds per square inch. All special joints required to be made and removed for the purpose of testing, will be executed by the contractor at his own expense.

The engineer of the gas company, or some employee appointed to represent said engineer, shall be present at every test. The necessary labor for locating leakage, by going over the work with soap suds, or by other method as may be directed by the said engineer, and for correcting same, shall be furnished by contractor. No test shall be considered complete until satisfactory to the engineer of the gas company.

When a defective casting is developed by any test, the cause for which is clearly the result of improper material or workmanship employed by the maker, and not discoverable prior to placing in trench, the same shall be replaced by the contractor. The costs of this replacing shall be accurately taken by the gas company, and an equal allowance be made the contractor; this allowance to include only actual expenses for labor and material used in executing the replacement.

When necessary to supply air in large quantity, steam pumping engine owned by the gas company shall be loaned contractor without cost; all teaming, labor, fuel and repairs necessitated by its use shall be supplied by the contractor at his own expense.

Backfilling.—All material taken from trenches shall, so far as possible, be returned to same upon backfilling. Any residue shall be removed by the contractor immediately upon the completion of backfilling at point where residue is found. In backfilling, earth only may be used for a space of not less than 6 inches all around pipe and castings, this to be carefully tamped under and around pipe so that proper bearing be given without lifting pipe from its bed as laid; all backfilling to be thoroughly rammed either continuously as thrown into trench, or in layers of not over 4 inches in depth.

Repaving.—Whenever ordinances of department of public works permit contractor to relay pavement, this shall be properly executed with proper materials by contractor at his own expense.

Where pavement must be laid by specific party under said ordinances, same shall be executed by specific party at the expense of gas company; pending such repavement contractor shall arrange pavement temporarily in a condition satisfactory to the city authorities and to engineer of the gas company.

In every case the contractor shall, after pavement is laid, keep same in proper repair at his own expense for one year from date of relaying; this proper repair to include any repaving made necessary on account of sinkage over trench. Whenever notified that any such repairs are necessary, the contractor shall see that the work of repaving shall commence within 48 hours of receiving such notice, otherwise the gas company shall have the right to cause such repairs to be made, and to charge the cost thereof against the contractor, on account of his contracts.

Protection and Responsibility.—The contractor shall carefully protect all property from damage by reason of the execution of work under his contract. The contractor shall assume all responsibility for and insure the gas company against any and all damage to life and property arising by reason of the execution of work under his contract. In the event of his failure to settle such claims within a reasonable time, the gas company shall have a right to adjust same and charge the amount thereof against the contractor's contract.

General.—The contractor shall at all times execute work cheerfully, and with all possible speed; shall cause the least possible inconvenience to vehicles and pedestrians, and, in case of any argument arising with any citizen or citizens, or servant or employee of any citizen or citizens, shall give way to the wishes of said person whenever same are reasonable, or may be carried out without serious cost or inconvenience.

Whenever it may be necessary for any reason to execute any portion or portions of the work at night, on Sunday or on holidays, such work shall be executed without extra charge or allowance.

No employee of the contractor shall at any time by any act or word provoke any person; the penalty for any such provocation shall be immediate discharge.

The words "gas company" used in this specification refer to the —— gas company, of —— city, or its successors or assigns.

The word "contractor" refers to persons or party with whom contract—based upon this specification—is made, and whose signature or initials are found hereon.

Prices, Etc.—Prices named shall cover work, as described here:

1. Excavation per cubic yard. For earth—this is understood to include sand, pebbles and pieces of broken rock, none of the dimensions of which exceed 8 inches. For loose rock—this is understood to include all detached or loose rock and boulders of larger dimension than that covered by the specification for earth, which does not require to be broken up to enable it to be removed from the trench. And for solid rock—this is understood to include all undetached rock and boulders, which, in order to open trench properly, must be broken up by blasting or other means to enable it to be removed from the trench.

2. Laying pipes and specials per running foot. This to include all work under this specification—*i. e.*, distribution of pipe, removal of pavements, etc. (exclusive of excavation only), and the relaying of pavement where contractor is permitted by ordinance of department of public works to execute same. Where contractor is not permitted to relay pavement, no reduction will be made on that account, the cost of the paving in this case being applied to, and to entirely cover the cost of removal of special pavement in point.

3. For setting drips. Per piece, line drip or side drip.

Payments and Estimates.—Payments shall be made by check on bank of deposit on each alternate Friday afternoon, after date of first payment, which shall be the second Friday after the commencement of work under contract. These payments shall be based upon estimates made by the engineer of the work done to the night of the Wednesday preceding the day of payment. In no event shall the total amount paid to contractor (this to include any charges which he may agree to have entered against him) exceed 90 per cent. of the total estimate value of work done. The remaining percentage to be held by the gas company for the period of one year from date of completion of work under contract, at the expiration of which period it shall be paid to contractor, upon the endorsement of receipt in full of payment for work done under contract as per final estimate of the engineer of the gas company.

The reservation in payments for work done is for assuring completion of work and keeping same in repair for one year. In the event of failure on the part of the contractor to complete the work in accordance with terms of contract (which contract shall include these specifications), then any sum remaining unpaid shall be forfeited to the company and retained by it as liquidated damages.

The estimates shall be calculated as follows:

1. Excavation.—Earth in cubic yards for a rectangular cross section of trench, where earth and loose rock only are found; the width of which for the various diameters of pipe shall be—viz.:

4	inch	diameter,	width	20	inch.
6	"	"	"	22	"
8	"	"	"	24	"
12	"	"	"	30	"
16	"	"	"	35	"
20	"	"	"	40	"
24	"	"	"	44	"
30	"	"	"	50	"
36	"	"	"	56	"

And the depth shall be equal to shortest measurement from surface of pavement to the top of pipe, as laid permanently in trench, for which calculation is being made, plus outside diameter of pipe—viz.:

Outside diameter of		4-inch	pipe	shall	be	considered	6-inch.	
"	"	6	"	"	"	"	8	"
"	"	8	"	"	"	"	10	"
"	"	12	"	"	"	"	14	"
"	"	16	"	"	"	"	18	"
"	"	20	"	"	"	"	22	"
"	"	24	"	"	"	"	26	"
"	"	30	"	"	"	"	32	"
"	"	36	"	"	"	"	38	"

Where solid rock is required to be removed for more or less of the cross sections of trench, it shall be in width equal to the inner diameter of pipe to be laid in it, plus 24 inches, and in depth shall be equal to the dimension from the surface of pavement to the mean grade of rock as uncovered in the trench.

Loose rock: In cubic yards, for the actual volume of material removed from trench, without reference to any cross section whatever.

Solid rock: In cubic yards, for a rectangular cross section of trench whose width shall be equal to width of cross section given for earth where solid rock is found, and whose depth shall be equal to the shortest measurement from surface of pavement to the top of pipe, as laid permanently in trench, for which calculation is being made, plus inner diameter of said pipe, plus 12 inches, less the dimension used for depth in calculation of earth excavation for same trench.

In all cases the space occupied by paving material shall, in calculation of excavation, be considered as occupied by earth.

Excavation for drips, in cubic yards, when in earth and loose rock, for cylindrical volume equal in depth to actual required depth of excavation, and in diameter equal to inside diameter of drip, plus 12 inches, when in solid rock, for cylindrical volume, equal in depth to actual depth at which bottom of drip is set, plus 6 inches, and in diameter equal to inside diameter of drip, plus 24 inches.

2. Laying pipe and specials: In running feet, measured in the trench when ready for backfilling.

Specials are to be measured double along center lines included in the running length of mains only, and from face to face of bells between which they are included. No castings shall be considered as specials other than bends, branches, sleeves and valves. When necessary to cut and lay short pieces of pipe in order to properly locate special, this shall be done without extra charge or allowance. The length of main included in a line drip, shall be estimated as running feet of pipe, and not be measured double.

3. Drips set: In number of pieces as set.

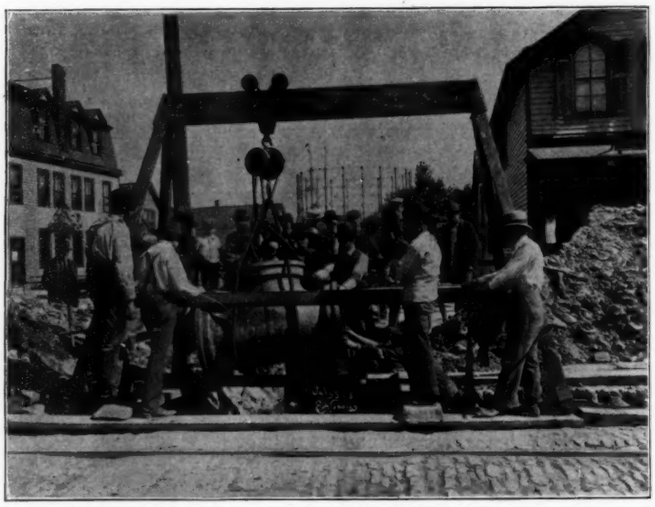
Appendix.—The lead room and weights of pipe appended here are given for the convenience of contractor, in making calculations of quantities, etc., the gas company in no way binding itself to hold even approximately to these figures, although it is its desire and expectation so to do.

Diameter of Pipe.	Lbs. per Foot.	Lbs. per Length.	Lead Room.
4 inches.	18	216	$\frac{3}{8}$ inch.
6 "	30	360	$\frac{4}{8}$ "
8 "	42	510	$\frac{5}{8}$ "
12 "	72	864	$\frac{7}{16}$ "
16 "	114	1,344	$\frac{7}{16}$ "
20 "	148	1,776	$\frac{7}{16}$ "
24 "	200	2,400	$\frac{1}{2}$ "
30 "	270	3,240	$\frac{1}{2}$ "
36 "	360	4,320	$\frac{1}{2}$ "

Discussion.

Vice-President Humphreys assumed the chair, and in asking Mr. Shattuck to open the discussion said Mr. Forstall had ably discussed a most important subject, that he ventured to suggest had not received in the United States the attention it deserved. The systematic oversight of street work was especially worthy of very careful consideration.

Mr. Shattuck then read the following contribution to the discussion—As to weights of pipe, I prefer the Philadelphia to the Society of Gas Lighting Standard in the case of 4-inch and 6-inch, on account of greater thickness insuring better hold for service ells and greater transverse strength. In case of the larger sizes (20-inch, 24 inch and 30 inch) I think the New York standard ample. A 24-inch pipe, $\frac{3}{4}$ inch thick, suspended as a beam, will sustain a central load of 110 tons. In the methods of connecting services or new mains to existing mains I differ with the method described by the writer, in that I object to split sleeves, service sleeves and saddle pieces. My objections are the difficulty of controlling the gas during the operation of putting on sleeves and the enlarged joint area after the service is connected. If bags are used why not cut in branch and be assured of a better job? In laying mains I believe it pays to hunt around for new methods. Experiments often pay for themselves very soon. I used a derrick on a 24-inch main this season which I believe far superior to the old-fashioned three or four-legged derrick. I have seen a four-legged derrick moved seven times in laying one pipe, where this derrick would have done the same work in its original position, and in the time ordinarily consumed in raising and lowering the pipe once. It consists of a traveler on a supported beam to which is attached a "Yale Town Triplex Hoist." One man can raise or lower a 24-inch pipe. The derrick is also provided with rollers on the base of the legs, and requires very little lifting. It can be easily taken apart and loaded on a single wagon. The weight of the derrick complete is 750 pounds. It is designed to handle 3,000 pounds. It cost $100. It has been suggested to make this derrick of angle iron. I have a picture of it here which may be interesting. It is quite obvious that eccentric specials are superior to concentric ones. In laying all branches a piece of pipe of a full length put in the outlet insures facility for extensions and preserves a future right of way. The bushing is preferable to the plug with a hub cast on. As to records, I may say that I had the advantage of learning the system of records de-



scribed by Mr. Forstall, as his assistant, and have since employed it. It is as easily used in rough country roads as in the city. The unit in roads I have taken as 1,000 feet, taking perpendicular measurements from street property lines and running measurments from dividing property lines, using a county map for an index map, and running in obscure property lines with transit. The beauty of the system is that any engineer can learn how to find all of your main information in ten minutes; or, in other words, some one else can read your notes besides yourself.

Granted that the system of inspection and records under discussion increases the cost of laying pipe, the saving in future facility in the handling of office records, unnecessary cutting of pavement, and looking for specials or joints not accurately located, would more than make up for the increased cost. I have made it a practice to locate a joint nearest each 50 foot station, and all cut pieces beside the specials. I think the specifications attached to this paper are very thorough, and require few changes for local conditions.

Mr. Littlehales agreed with the Chairman that this was a most important subject. Many of them did not thoroughly realize the difficulty of making tight joints. In testing some pipes he found that the fire test was worthless, and he had further found that soap suds did not afford an infallible test for locating leakages in mains. In fact, it was a question whether part of the leakage might not be attributable to the porosity of the metal itself, which would be a difficult thing to reach. Of course the greatest trouble was due to a desire for either too rapid or too cheap work. He thought it was at least unreasonable to hope for good results in main laying that had been rushed. The subsequent trouble and expense in correcting the defects in such work were sufficient to pay for work well done at first. He would like to have from the author a statement as to the smallest leakage per mile of main of which he was cognizant; that is, feet per mile per day or per annum. He would like from his point of view to emphasize the misleading character of figuring leakage on percentage. He knew of one company reporting a leakage of 4¾ per cent., with an actual leakage of 1,490 feet per mile per day, whereas another that returned a leakage of 12 per cent., was really losing 700 feet per mile per day. Although the percentage was almost three times that of the other, the leakage was in fact only about one-half. Mr. Forstall's system of connecting mains was an excellent one. Mr. Cathels, too, had a good arrangement for plugging off extensions of mains that he may describe to you. It consists of a series of rubber rings reinforced by plugs that can be pulled along like a ramrod in a gun barrel. It seemed to him an omission in the specification cited was in the failure to provide for the removal of ashes or the substituting of soil for ashes where the pipe ran through made ground. His experience was that ashes were very destructive to mains or services. Cast iron pipe laid in ashes was speedily pitted. In Europe the practice in main specifications was to insert therein stipulations that wherever ashes were found in the trenches they must be replaced by sound soil. No fault could be found with the plan proposed for recording. He hoped Mr. Forstall would give them an opinion how much per mile should be considered standard work in main laying.

At this point Mr. Littlehales exhibited a model of a device used by him for measuring length of mains in use, an illustration of which is appended. In describing it Mr. Littlehales said: It is a home-made article, and most of you will recognize the shape. The wheel is from a child's small express wagon. To get it of the right diameter he soldered on two bits of tin, and an old, discarded 20 light meter index, geared in such a way that as the shaft turns the 10-point pinions gear into the wheel, so that as the wheel turns around it indicates 1 yard for every

revolution. It is very convenient if you send a man to the other end of the city to ascertain how much main will have to be laid. There is no question about his counting right the steps he takes. The bicycle arm connected with the wheel cost $1, the wheel cost 50 cents, and the total cost, including labor, was $3.75. It is not patented.

Mr. Witherby said he had a bicycle, the cyclometer of which was geared to record yards instead of miles.

President Crockett here resumed the Chair, and inquired if Mr. Jenkins would take part in the discussion.

Mr. Jenkins replied that Mr. Forstall had so thoroughly covered the ground that little room was left for discussion. Perhaps, however, one or two points were worth elaborating. For instance, the author says a 1¼ inch is the smallest service run, and all services, to 4 inches inclusive, are of wrought iron. The speaker did not believe in going over 3 inches with wrought iron services. Mr. Forstall also says, "A 1¼ inch service would be connected to a 3-inch or 4-inch main, by a split sleeve tapped for a 1¼-inch or a 2-inch hole respectively." Mr. Jenkins thought it was better to put on the sleeve at once, giving the full opening wanted for the service right at the main; likewise in tapping a 2½-inch service for a 6-inch main with a 2 inch opening, he would prefer to have a 2½-inch opening. A very important point had been recorded on page 5 of the paper, where it was said: "Outside of the necessity for greater vigilance in order to obtain tight joints where contacts are let, there is the serious disadvantage, especially in large cities, of the indifference to the comfort of the public that is so often characteristic of contractors." He thought they could not be too careful in that instance, for in tearing up the streets of large cities it behooves them to put to as little inconvenience as possible those using or living along the line of the disturbed roadway. He found that offset pieces often came in quite handy. While laying a 20 inch main this summer they had to go under a 36-inch water pipe, just beyond which they had to go over a 24-inch pipe. The use of two 20-inch offsets allowed them to bridge the one and go over the other. The President invited Mr. Rusby to speak to the topic.

Mr. Rusby said that in Jersey City they had just completed a pipe job laid by themselves rather than by contract. He noted that on page 11 of the paper Mr. Forstall stated that, in cutting out the head of a 36-inch plug he was first compelled to remove a 12-inch plug in the bushing, and he would like to know how it was done. The specification

quoted for laying mains requires the use as supports of two blocks for each length of pipe, one near the bell, the other near the end. He objected to allowing support of that kind under pipe, for it was apt to be relied upon to do the supporting, for which it might not be competent, as the bearing surface of the two blocks was comparatively small.

Mr. A. S. Miller said that a reference to the report on the standards of the Society of Gas Lighting would show they were simply weights suggested, with the further qualification that every engineer should decide as to weights according to local conditions. On page 6 Mr. Forstall said, "Where long lines of large pipe are to be laid, and work has been begun at the cheapest end, it is interesting to watch the keen endeavor to keep down the increase in cost that naturally comes as more expensive conditions are encountered." Are they to understand that "endeavor" is to be interpreted as meaning that the work suffers in consequence? On page 11 it is said: "Its working (bell) end was closed by a plate of wrought iron clamped on a rubber gasket upon the face of the bell." Now as rubber is soluble in gas, he thought that was very bad practice. An asbestos gasket was practically indestructible. The specifications were elaborate and fine from the point of view of the gas company; but it must be remembered that the contractor is expecting to make a fair profit, and if they dealt with him on the basis that he was to reap a fair reward the results all round would be more satisfactory. Close examination of the specifications showed an enormous number of contingencies, and if it is expressly stipulated that no allowance is to be made therefor the contractor is figuring in the dark, and they might be sure that in his estimate he would try to save himself, especially if the contractors in the district where the work was to be done had a fair "understanding" amongst themselves. It seemed to him the specifications could be improved by allowing a reasonable amount for any extra work, such as the changing of a main due to an unforeseen condition. A certain number of test holes, for instance, should be provided for along the proposed lines of trench, and if the line had subsequently to be changed allow the contractor fair compensation if it involved extra work. In fact, when any question arose during the progress of the work they should give due heed to the contractor's part of the argument.

Mr. J. J. Humphreys, Jr., said that experience had pretty thoroughly convinced them that the pressure gauge was not a reliable one, especially on long stretches of mains of large diameters—20 inch or over. He believed in the soap bubble test for joints and in the hammer test for cracked pipes or bells.

Mr. Mayers, Detroit, Mich., said the soil often had a very bad effect upon wrought iron pipe. They had a 16-inch main that had not been used for some time. They instructed a foreman a short while ago to examine a steel gate at a certain point on the line. He reported that the gate was in good condition, but that the pipe was badly corroded. The pipe had to be replaced. Nothing was said in the paper about putting in fittings at intersections, and it seemed to him that where they were required to lay an absolutely straight line it would be better to lay a small main (up to 8 inches) to avoid putting in any specials in sections.

Mr. W. Forstall said, referring to criticisms on the methods of connections, he knew the scheme was open to objections, and they might change it later on. Regarding Mr. Littlehales suggestion about rushing the work too much, and the similar criticism by Mr. Miller, it was understood that good work was not to be sacrificed for the sake of speed. Respecting the failure in the specifications to cover the replacing of ashes by good dirt, no ashes were encountered in the city for which the specifications had been prepared. As to allowable leakage his experience was limited. Years ago when attempting to bring down the leakage on 20 miles of main in a country town, his original aim was to get it to 33,000 feet per mile of 3-inch main per year. In the end though he was satisfied with anything under 100,000 feet. As to Mr. Jenkins's preference for cast iron for services 4 inches and upwards, they used wrought iron because of the many obstacles often found between the main and the curb, and their disinclination to put in the number of lead joints probably needed with cast iron under the conditions. Replying to the inquiry by Mr. Rusby in the matter of taking out the 12-inch plug a 36-inch bag was used in the arm of the cross, thus stopping most of the gas. It would not have been possible to use the 36-inch bag for taking out the 36-inch plug. Mr. Miller suggested that the weights of mains indorsed by the Society of Gas Lighting were in the nature of recommendations rather than as a standard; but he once got a lot of pipe of the weight named by the Society (he had not specified any weight), which went to show that the particular foundry regarded the recommendation as a standard. Again, the rubber gasket was only in temporary contact with the gas. Regarding the stringency of the specifications, these were the result of many differences with contractors, obliging them to provide for such contingencies in the future. Since the specifications were put on the present lines their misunderstandings with the contractors had been few. One of the great advantages of contract work was that it enabled them to know in advance the cost of any job. He believed, however, that a company should do its own work wherever possible. Respecting pipe testing he thought every workmanlike foreman tested his pipe with a hammer before it was laid, and that in the pressure tests all joints were tried with soap suds. Of course regard must be had to temperature in reading a mercury gauge. As to this failure to specify anything about settings of specials, he thought that practice was closely allied to personal opinion. However, in large cities, as gas companies usually had certain rights of way assigned them, specials could be set at such distance from the curb that they would be in the right place when needed.

Mr. Neal asked Mr. Forstall whether he connected his services directly with the mains or by offsets.

Mr. Forstall replied that he used a straight tee with a male thread on one end and a female thread on the outlet. It was the same way with their swing joint. The tee should be a straight one.

Mr. W. A. Miller asked why Mr. Forstall did not think it preferable to use a blank flange piece, bolted to a piece of flange pipe instead of using a rubber gasket.

Mr. Forstall replied that having the pipe on hand they used it. They regarded this temporary piece only as a tool. It was in service only two or three hours.

Mr. Littlehales thought that Mr. Forstall was right in saying that 100,000 cubic feet leakage per mile per annum would be a good standard. The lowest, so far as he had record, figured out 229 cubic feet per mile per day, and as Mr. Forstall's figures were 274 cubic feet, they were not far apart. The worst case that had come to his knowledge was 1,935 cubic feet per mile per 24 hours.

On motion of Mr. Egner a vote of thanks was passed to Mr. Forstall for his paper.

Place for Next Meeting.

The President called for the report of committee to name next place of meeting, which Mr. C. J. R. Humphreys read as follows:

Your Committee appointed to recommend the place for the next meeting of the Association beg leave to report as follows:

Your Committee would acknowledge, with thanks, the invitation to hold the next convention at Hartford, Conn., but the sentiment of the majority of the members of the Association, as expressed to this Committee, seeming to be in favor of New York city, your Committee would recommend that the next meeting of the Association be held in New York city. Respectfully,

C. J. R. Humphreys,
E. H. Jenkins,
L. L. Kellogg,
} Committee.

On motion of Mr. Neal, the report was approved.

Report of Committee on President's Address.

Mr. A. E. Boardman read the following report from the Committee on President's address:

Mr. Chairman: Your Committee appointed to report upon the President's address has been greatly pleased with the many points of interest treated therein and the living issues discussed. It is difficult to select from a paper so replete with suggestions those most profitable to consider. However, we respectfully impress upon this convention the pertinent remarks of the President upon the menace to private property of the attitude of many municipalities in their efforts to acquire the public utilities works. This desire on the part of the people is very widespread, and is intensified in many instances by designing politicians for selfish ends. Believing, as we do, that this movement is consequent upon erroneous ideas of the ultimate economics to the community, and mistaken and imperfect reports from those municipalities operating gas, water and electric works, we deem it important that the members of this Association should post themselves thoroughly upon all the points bearing on this subject, so as to be prepared to refute the errors into which the people are being led, and to point out the omissions and inaccuracies in the reports creating these false impressions. If charged with taxes, state, county and municipal, with interest upon the cost of the plant, with depreciation and such other proper items as the privately owned plants are subjected to, the municipally owned plants would show a far greater cost to the community than is popularly believed. Hence we would recommend that the officer to be in charge of the educational work of the Association be also entrusted with collecting and compiling for ready reference the statis

tics and arguments on both sides of this question, published throughout the country, for the use and information of the members of the Association, and that each member aid the officer by sending to him marked copies of publications bearing on the subject that may appear in his locality.

We have considered with deep interest our President's review of the question of educating young men for the gas profession. We are glad to agree with him in his approval of some plan for accomplishing this much desired purpose, and would respectfully recommend the Educational Committee to carefully consider this question. But if your Committee are competent to offer suggestions, we would respectfully say that we approve of the plan proposed by the Educational Committee, as that plan reaches immediately those who wish to learn and are already engaged in the practical work of supplying gas to the public. The plan proposed by the Educational Committee is similar to the system of education in use by the University of London. Young men anywhere in the British Islands can study at home such subjects as are recommended by the University, and at stated periods go to London for examination by the Faculty, and degrees acquired by this process are very highly valued. The plan pursued by some of the correspondence schools in this country might be examined with advantage.

Attention is called to the danger of our mains and services from the electrolytic action of street railway currents. Although much has been written in the past upon this subject, it is probable that an additional paper, giving practically and in very full detail the methods of testing our mains for the existence of current, how to suppress it, the points in our mains system especially liable to injury, etc., would be of service to our members. We recommend to the Association the preparation of such a paper. Respectfully submitted,

A. E. Boardman,
John McIlhenny,
David H. Geggie,
B. E. Chollar,
J. M. Rusby,
} Committee.

On motion of Mr. Neal the report of the Committee was accepted and its recommendations adopted.

An Invitation and a Telegram.

The Secretary stated that one of their active members (Mr. G. T. Thompson), who is also President of the Western Gas Association, in writing to him a few days before the meeting, said that as neither he nor Mr. Dunbar, the Secretary of the Western Association, would be able to be present at this meeting, he would like him (the Secretary) to extend to the American Association the cordial invitation of the Western Association to attend its annual convention, at Milwaukee, on the third Wednesday of May next, either in a body or individually, and assure them of a hearty welcome. He had great pleasure in conveying Mr. Thompson's invitation to the Association.

On motion of Mr. Butterworth, Secretary Forstall was instructed to send the following telegram in behalf of the American Association:

To Mr. George Treadway Thompson—The American Gas Light Association, in convention assembled at Niagara Falls, learns with deep regret that you are unable to meet with us on account of your illness. We miss you, and express our best wishes and hope for your speedy recovery.

On motion a recess was ordered.

[To be Continued.]

Reconstruction of the Longton (Eng.) Corporation Gas Works.

[A paper prepared by Mr. W. S. McGregor, for the Midland Association of Gas Managers.]

It may be stated at the outset that the design, manipulation, and control of all mechanical appliances introduced into gas works, has now become a subject of the greatest economic importance; and the majority of gas engineers, in designing modern works, arrange for their introduction with a view to economy and less dependence upon skilled labor, besides the greater facilities obtained for handling material—objects to be all the more strongly borne in mind in view of the Workmen's Compensation Act, and its probable demands upon employers. Gas making has changed but little during the last fifty years—*i. e.*, the principle remains the same, although many improvements have been made for carrying on the process. Still, as it is the aim of every engineer to produce the greatest quantity of gas from a ton of coal at the smallest cost for wear and tear, fuel and labor (due consideration, of course, being given to the quality of gas supplied), this principle has to a great extent guided the writer in designing and carrying out labor-saving appliances during the reconstruction of the Longton Corporation Gas Works.

The new retort house is 90 feet 6 inches long by 70 feet wide between walls, and 35 feet 6 inches from ground level to wall plate. It is a plain but substantial building of two floors—the basement and working floor—presenting a massive appearance, quite in keeping with the work for which it is designed. The basement or cellar floor is used for discharging and cooling the coke, and attending to the furnaces. From the basement floor access is had to the underground engine rooms, where a 10-horse power engine of the vertical type is used to drive the coal breaking, elevating and conveying machinery. The walls are lined with white glazed bricks; and these, of course, give a cheerful and cleanly appearance to the engine rooms.

The working floor is carried on heavy steel girders, supported on cast iron columns and steel joists with brickwork arches. In fact, throughout the whole of the work steel has entered largely into the construction, owing to its superior qualities of lightness and strength. It is rather unusual to design a house of this size with two floors. The reason that this type of house was adopted was that a large drainage culvert passes directly across the site, about 4 feet below the yard level; and as this precluded the building of a cellar for the regenerator retort settings introduced, it was finally decided to build a stage floor house, which, although somewhat more expensive in first cost, soon repays the outlay, owing to the greater facilities obtained thereby for handling the coke. The retort house is spanned by a light steel roof, the main principals being 72 feet long, with a rise of 17 feet 6 inches. A ventilator 10 feet wide, running the whole length of the roof, provides ample space for the exit of smoke, steam, etc. The total weight of the steel used in building the roof is just under 31 tons; and it is noteworthy that not a single forging has been required in fixing the roof. The retort settings are arranged for the introduction of mechanical stoking (manual), and are also designed with all the latest modern improvements of hydraulic main, gas and tar valves, flushing apparatus, etc.

As space would not permit of the erection of coal stores on each side of the retort house—nor, indeed, would the capital invested pay for interest and sinking fund charges on stores, owing to the works being situated so close to the North Staffordshire coal fields—it became a problem how to obtain the best results in "coal trimming," as a large portion of the saving is effected in this direction. It was finally decided to construct two elevator and coal breaker pits directly underneath the railway lines running along each side of the retort house; each pit to contain steam engine, coal breaker and elevator, into which the coal is delivered by means of bottom doors in the railway trucks. The elevators each deliver into storage hoppers of 7 tons capacity, fixed in the retort house; so that either elevator can feed both sides, thus minimizing the chance of a breakdown. The coal is shunted in from the railway sidings; the wagons being run directly over the receiving hoppers.

As all the trucks are provided with bottom doors, little difficulty is experienced in emptying the wagons; while with hopper wagons, built specially for this traffic, hand labor is reduced to a minimum. The receiving hoppers over the coal breakers are provided with adjustable doors, so that the supply of coal to the breakers can be regulated according to the size or quantity required. The breakers are driven by a separate steam engine of the vertical type, which also drives the elevator and conveyor. The elevators consist of 12-inch steel buckets, spaced 18-inch centers, fitted to a strong detachable link chain of cast steel, provided with lugs for fastening bolts and sliding gear; and the buckets are guided by a latticed steel framing, bolted on H steel girders built into the retort house walls. These elevators are driven by belt and chain gear combined. The belt drive is adopted for the purpose of preventing any damage being done should a piece of iron or other foreign material find its way into the coal breaker, the belt having a tendency to slip immediately this occurs. After leaving the elevators the coal is delivered into an overhead storage hopper or conveyor, as required. The conveyor consists of a flat cotton band, kept taut by means of rollers; and it is so arranged that it can be driven by either elevator or overhead hoppers.

The drawing machine is of the usual rake type, mounted on a triangular frame running on rails in front of the charging machine, and parallel to the retort bench. The charging machine consists principally of a movable hopper carrying about 3 tons of coal, and fixed on an upright frame running on rails in front of the bench, and, like the drawing machine, parallel thereto. The charging machine is provided with steel traveling wheels, cast malleable traveling gear, and rope hoisting gear for raising and lowering the adjustable hoppers to the three tiers of retorts.

For disposing of the coke, movable wrought iron plates are fitted in front of the retort bench immediately over the coke shoots, delivering the coke into side tip wagons placed underneath. The coke shoots are carried on brackets bolted to the buckstaves, and are made **V**-shaped to allow of the men having free access to the clinkering doors. For conveying the coke to the yard, a narrow gauge tramway, 20-inch gauge, is laid down; and side tip wagons of 25 cubic feet capacity are used. These wagons will ultimately be hauled out and in by means of an endless rope, although at present they are being worked by hand. For quenching the coke, water pipes provided with a rose are placed one over each coke shoot, and also a water tank of 500 gallons capacity over each line of tram outside in the yard. It is intended that the coke, after being thoroughly cooled, should be tipped into the boot of a coke elevating and breaking machine, broken to size, elevated, screened and delivered into trucks, or the smaller sizes washed for smiths' use.

The exhausting plant has been completely remodeled; a new engine and exhauster of 50,000 cubic feet per hour capacity having been fixed, and the two existing exhausters coupled up to one engine direct—thus doing away with belt driving. The new exhauster is of the four-blade type, and the engine is controlled by gas and steam governors. A new rotary washer scrubber, driven by a horizontal steam engine, has been erected, and is capable of removing the ammonia and other impurities from 1,000,000 cubic feet of gas per 24 hours, and will certainly repay the outlay in the increased yield of residuals.

A new station meter has been built, of 50,000 cubic feet per hour capacity, and is erected in an outwardly plain but substantial building, although some little taste has been displayed in the interior decorations, notably the roof, which is stained and varnished. A cabinet of scientific instruments for recording illuminating power and pressure, together with the regulator for controlling the supply of gas to the borough, and a petroleum enrichment plant, make this one of the most interesting places in the works. A new leading main has been laid from the works to the Town Hall, and a new trunk main joined thereon to increase the supply to Dresden and district.

Another very interesting feature in the works is a small electric light plant, with which the purifying shed, the governor house, engine room, offices and manager's rooms are lighted. It is a continuous current dynamo run at 110 volts, and is capable of supplying sixty 16 candle power incandescent lamps, and has already proved itself eminently useful in enabling purifiers to be attended to at night, in case of breakdown.

The extensions have cost about £15,000, and the writer considers the money has been well and judiciously expended, and trusts his brief *resumé* may prove interesting to the members.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

INVITATIONS are "out" for the "opening of the works" of the Peoples Gas Improvement Company, of Trenton, N. J. The ceremonies are to be held at 2 o'clock to-morrow, and the invitation informs the recipients that the works are located at Brunswick and Paul avenues.

THE Brookline, Dorchester and Jamaica Plain Gas Light Companies, all doing business in the immediate vicinity of Boston, Mass., have notified the residents of their respective districts that certain decreased rates are in prospective. The notification issued by the Brookline and Dorchester Companies is as follows: "The undersigned hereby give notice that, having arranged with the Massachusetts Pipe Line Gas Company for the purchase of coal gas at a lower price than that for which they have hitherto been able to manufacture it, they will supply coal gas in place of water gas whenever the said Massachusetts Pipe Line Gas Company is ready to furnish it. From and after that time the price of gas used for fuel, when supplied through a separate meter, will be 75 cents per 1,000; when used in gas engines, of a type to be approved by the Company furnishing the gas, 1½ cents per horse power per hour up to 100-horse power; in engines of from 100 to 200-horse power, $1\frac{1}{5}$ cents per horse power per hour; in engines of 200-horse power and over, 1 cent per horse power per hour; for gas supplied to gas furnaces, of a type to be approved by the Company furnishing the gas, 50 cents per 1,000 cubic feet. All parties interested are requested to communicate with the undersigned at their several offices, who will be pleased to give information in regard to the kind of apparatus best adapted to accomplish a satisfactory result." Mr. E. G. Storey signs for the Brookline Company, as its Treasurer, and Mr. F. P. Addicks acts in similar capacity for the Dorchester Company.

THE statement by the Jamaica Plain Company, which is over the signature of its Treasurer, Mr. E. N. Foss, is appended: "The Jamaica Plain Gas Light Company will join in the prices above named, and will reduce its price for illuminating gas from $1.25 to $1 per 1,000 cubic feet, whenever the Massachusetts Pipe Line Gas Company is prepared to supply the gas for which the Company has already contracted."

THE Kerlin Brothers Company, which is now in control of the natural gas plant formerly operated on municipal account by the authorities of Tiffin, O., announces that gas will be furnished only by meter measurement, the rate per 1,000 to be the uniform one of 25 cents.

THE proprietors of the Cambridge (Mass.) Gas Light Company have announced that on and after April 1st, 1899, the rate for gas shall be $1 per 1,000 cubic feet. The current rate is $1.20.

THE American Gas Meter Inspection Company, the home office of which is said to be in No. 2 West 14th street, New York, is canvassing for customers in the territory supplied with gas by the Hudson County Gas Light Company, of Hoboken, N. J. The Inspection Company's terms are: If the meter tested proves correct, no charge; if the meter proves fast or slow, the consumer is to pay $2.50, provided the meter is less than 100-light capacity; if it is a 100-light, the payment is to be $3.50; if over 100 light, $5. We do not think the Company will transact a large business, from the simple fact that the laws of New Jersey provide that anyone disconnecting a meter for the purpose of making a test thereof, unless such person has the distinct authorization of the local gas company, is liable to be arrested for a misdemeanor, and if conviction follows the charge the culprit may be punished by fine and imprisonment. The maximum sentence on first account is $250; on the second, two years. Both penalties may be imposed for the offence. President Dod, of the Hudson County Company, has seen to it that these things have been fully brought to the notice of those resident or doing business in its territory.

GAS doings in the far Eastern section of the gas trade are quite prominent just now, and the developments therein are well worth watching. In fact, some of the developments are amusing to those who have always believed that gas was not vapor, in which understanding the following lines from "Observer" will be appreciated. Our correspondent says: "Within the past few weeks the Massachusetts Pipe Line Gas Company has attracted attention to itself by a series of advertisements in the Boston newspapers, which reminds one of efforts in this line made years ago. The intention is evidently to influence public and legislative opinion, and so, indirectly, to help on the consolidation scheme; this meaning to include the exploitation of Dominion Coal Company's stock, the yet-to-be-issued Pipe Line stock and sundry other favors desired at the hands of the public. Since last year work on the plant at Everett has gone steadily on. It is located on the Mystic river, to the east of Boston proper, and adjacent to the cities of Malden, Charlestown, Chelsea and East Boston. It fronts the river, before which in process of construction is a wharf with a frontage of 1,000 feet. On the wharf are the most improved facilities for unloading coal into the bins and for the shipment of coke into vessels, or by loaded cars, into lighters. When the dredging is completed vessels drawing 20 feet of water can discharge. The works are planned for 800 Otto-Hofmann ovens, of which 400 are to be placed this season. These are to be located in 8 oven houses, 50 in each domicile. Four of the houses are well underway now, although the ovens in the set are barely started. In the other set the reverse is true, the ovens being about completed, the buildings serving as temporary covers. The condenser, engine and boiler houses are approaching completion; but not much of the machinery is as yet installed, save the boilers, of which 2,000-horse power are in position. Work on the 1,000,000-foot holder has just been commenced, and the men of Messrs. Bartlett, Hayward & Co. are putting the bottom sheets of the steel tank in position. Cannection with the tracks of the Boston & Maine Railroad, at the Company's junction at Everett, has been made, and material thus may be received by either rail or water. The work so far done is of a most expensive and substantial character. Neither labor nor expense seems to have been spared to secure the best of everything. Gas is promised to be delivered in April, but it is hardly possible that much can be distributed before next fall. It may be remembered that the Legislature last year ordered the Board of Gas and Electric Light Commissioners to report to the incoming Legislature some method of consolidation for the Boston gas companies. A hearing on this matter was extensively advertised by the Board, at which only a few appeared; and practically nothing was said, either at the first hearing or at the adjournment session one week

later, the Pipe Line Company, whose profits are most concerned, evidently desiring that its plaint should be heard during the Board's privacy. Through the time of the hearings (and all these things must be considered to enable one to form a just opinion respecting the case), the Mayor of Boston has approved an amendment to the contract of the Brookline Gas Light Company (the contract was made in February, 1893), whereby the Company was allowed to do business in Boston on the condition that it distributed gas 'not less than 25-candle power.' The amendment consists of adding the words, 'unless coal gas be distributed, in which case the candle power shall not be less than 18.' Mayor Quincy is a gas man, in that he is interested, as Director or otherwise, in several gas companies; but it is doubtful if he took the time (although com mon fame has it that he is advised by that distinguished member of the New York bar, Mr. H. Allen Odell) to figure out the amount of money he was losing to the citizens who were using Brookline gas. Had he approved an order authorizing the Water Board to write three quarts of water a gallon on all its bills to the public, such signature would probably have caused a sensation. What is the difference? The Brookline Gas Light Company, to June 30, 1898, sold $732,329 worth of gas. To obtain the same lighting value from an 18-candle gas would require an expenditure of one-fourth more, or the customers of the Brookline Company must expend $183,085 additional in order to obtain the lighting value that was theirs under the 25-candle regime. This action of the Mayor, his reasons, and a long letter from Mr. Whitney to the former, have all been advertisedly published, which publishings have been followed by an advertisement, from the respective treasurers of the Brookline, Dorchester and Jamaica Plain Companies (which Companies form the western quarter-circle of Boston's suburbs, and which are all under the Brookline management with Mr. Whitney as President), stating that, when the Massachusetts Pipe Line Gas Company is ready to supply gas, they would furnish gas for fuel, through a separate meter, at 75 cents per 1,000 cubic feet, and that gas to approved gas engines would be sold at other lower rates, the 'lower' rates to be scaled on the basis of a horse power hour. This naturally will cause a demand from the Boston public that consolidation take place, for by no other means can they apparently obtain the promised benefits that their suburban fellows enjoy. Editorially, the Boston papers have shown gas users how this may be accomplished, but let me say when it is 'accomplished' Boston will pay, on the basis figured above, some $400,000 more per annum for equal light from 18 candle gas—always remembering the photometer and the liability of personal error in its use—than from the 25-candle article. But after all, as the Boston *Transcript* says, 'If the advantages to the public are so plain and obvious, why is it so necessary to advertise them.' There seems to be no good reason why the consolidation should not be permitted, if it is to be an above-board transaction; and it cannot well be otherwise under the laws of Massachusetts, which include the 'keen' supervision of the Board of Gas and Electric Light Commissioners. Meanwhile, as a financial feature, B. S. gas, Dominion coal and Butte and Boston c›pper are enjoying a boom."

THE Brookline (Mass.) Gas Light Company's shareholders may be interested in hearing that its managers have agreed to pay them, since the 2d inst., a quarterly dividend of 2½ per cent. Yet from some of the foregoing matter, it seems that the "Pipe Line" is going to sell gas to the Brookline Company!

MR. JOHN O. RICE, of Portland, Me., was the expert appointed to examine the books of the Bath (Me.) Gas and Electric Company, following the difficulty in which the Company was put by the odd acts of some of its officers.

MR. JOHN WATT has charge of the main extension work now underway by the Lambertville (N. J.) Gas Company.

THE new owners of the Green Bay (Wis.) gas properties propose to reduce the selling rates to $1.50 on lighting account and to $1.12½ on fuel account. Current rates are, respectively, $1.75 and $1.25.

THE concern which is said to have "financed" the reorganized gas properties of Newark, N. J., and vicinity, has elected the following officers: Directors, Jerome Taylor, William Scheerer, Ebenezer C. Hay, Thos. N. McCarter, Jer. O'Rourke, Thomas A. Nevins, Adrian Riker; President, Thos. A. Nevins; Vice-President, Wm. Scheerer; Secretary, Clarence L. Nelson; Treasurer, Jas. P. Dusenberry. It is quite likely that the named officers are merely protocolists.

AT the annual meeting of the Sherbrooke (Can.) Gas Company it was agreed on to issue a new mortgage debt of $75,000, the proceeds to be applied to the retiring of the existing mortgage debt and to extensions on plant account. The officers chosen were: Directors, R. W. Heneker, T. J. Tuck, W. Blue, F. P. Buck and A. J. Lomas; President, R. W. Heneker; Vice-President, T. J. Tuck; Secretary and Treasurer, E. F. Waterhouse; Supt., Andrew Sangster.

Liquid Hydrogen.

"W.," writing in the *Journal of the Franklin Institute*, says: The advances that have lately been made in the improvement of the mechanical details of apparatus, have been so substantial that the liquefaction of air—until lately a most difficult and costly operation—has become so common that it has ceased to be a novelty. The English chemist Dewar, in 1893, first drew attention to the subject by his remarkable experiments with the material at the Royal Institution in London. In these demonstrations he was enabled to produce only minute quantities of liquefied air with infinite difficulty, and at a cost which is said to have been at the rate of $2,500 for a quantity not exceeding a quart.

Since then, Linde, in Germany, and Tripler, in America, by improved compression apparatus, have shown that liquid air may be produced continuously and have supplied the product in large quantities, comparatively speaking, and at a cost of not exceeding, it is said, $1 per pound.

Tripler's work in this field has recently attracted much public interest, from the fact that he has supplied liquid air in quantities of from 5 to 10 gallons for lecture demonstrations before various learned societies. One of these occasions was some months ago, at the Franklin Institute, where something like 8 gallons of liquid air were used, which had been shipped from New York in vessels resembling large milk cans, with no other precautions than placing the vessel containing the liquid within another, the space between the two being lined with felt.

Hydrogen, however, has, until quite recently, apparently successfully defied all attempts to liquefy it. The claim has indeed been made by certain experimenters that a momentary mist within a glass tube indicated the incipient liquefaction of the gas, but these observations have been of so equivocal a nature that they have been accepted by scientific men with reservation.

At last, however, Professor Dewar has unquestionably accomplished this unique scientific feat, and has exhibited the liquid to Lord Rayleigh.

The successful experiment was made in the laboratory of the Royal Institution—the theater of so many scientific triumphs at the hands of Humphrey Davy, Faraday and Tyndall—where Professor Dewar, according to the authority of the London *Times*, "actually produced the liquefied gas to the amount of half a wineglassful in five minutes by a process which would equally have produced a pailful had the requisite supply of pure hydrogen been forthcoming."

With no present or prospective practical usefulness attached to this achievement, it is not only of surpassing scientific interest, but also of great scientific importance, since it places at the service of investigators a means of commanding much lower temperatures—much greater cold—than it has hitherto been possible to attain, and scientific investigation has been compelled to stop far short of the limit of cold which liquid hydrogen can be made to yield.

In commenting on the properties of liquid hydrogen, the *Times* calls attention to the fact that the boiling point may be placed about 30° to 35° of absolute temperature; that is to say, about 240° below zero on the Centigrade scale. The following experiment is described to afford some conception of the degree of cold attained, viz.: If a tube closed at the lower end be immersed in the liquid hydrogen, it is almost instantly filled with solid air. The density of the liquid hydrogen is slightly more than half that of water.

One of the noteworthy things accomplished by Professor Dewar with this liquid, was the liquefaction of the rare gas helium which had hitherto resisted all attempts to effect its liquefaction. The boiling point of helium appears to lie very near to that of hydrogen itself.

The successful liquefaction of these two elements leaves nothing further to be done in this direction. There are no longer any known gases that remain in the category of incondensables, or permanent gases, as it was once the convenient mode of describing them.

It may be said in conclusion of the subject that nothing now stands in the way of the production of the liquid hydrogen in any desired quantity except the obstacle of its cost. This will always remain considerably higher than that of liquid air, because of the original cost of making hydrogen gas, but mainly because of the much greater difficulties attending its liquefaction. It will undoubtedly prove a valuable agent in the hands of physical and chemical investigators in the prosecution of researches that promise to add substantially to our knowledge of the ultimate constitution of matter. We can now reach down to within 30° of the absolute zero, where all matter is believed to be inert, dead.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

THOS. J. CUNNINGHAM,
ELBERT P. CALLENDER,
EDITORS.

CHAS. E. SANDERSON,
MANAGER.

PUBLISHED ON EACH MONDAY OF THE YEAR AT
No. 32 Pine Street, New York.

The JOURNAL is the official organ of the
NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.
AMERICAN GAS LIGHT ASSOCIATION.
WESTERN GAS ASSOCIATION.
OHIO GAS LIGHT ASSOCIATION.
PACIFIC COAST GAS ASSOCIATION.
TEXAS GAS AND ELECTRIC LIGHT ASSOCIATION.

MONDAY, NOV. 14, 1898.

Gas Stocks.

Quotations by Frederic R. Cochran & Co., Brokers and Dealers in Gas Stocks.
20 AND 22 BROAD STREET, NEW YORK CITY.

Nov. 14.

☞ All communications will receive particular attention
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$37,730,000	100	184	185
Cental Union, Bonds, 5's	3,000,000	1,000	101	101½
Equitable Bonds, 6's	1,000,000	1,000	105	.
" 1st Con. 5's	2,300,000	1,000	114	.
Metropolitan Bonds	658,000	.	108	112
Mutual	8,500,000	100	305	315
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	.	.
New Amsterdam Gas Co.	13,000,000	100	28¼	29½
Preferred	10,000,000	100	67½	68
Bonds, 5's	11,000,000	1,000	101¼	102
Northern Union, Bonds, 5's	1,250,000	1,000	94½	95½
New York and East River..				
Bonds 1st 5's	3,500,000	1,000	111	113
" 1st Con. 5's	1,500,000		107½	108½
Richmond Co., S. I.	348,650	50	70	..
" Bonds	100,000	1,000	.	.
Standard	5,000,000	100	132½	140
Preferred	5,000,000	100	149	155
Bonds, 1st Mortgage, 5's	1,500,000	1,000	112	114
Yonkers	299,65	500	130	
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	126	127½
" " Bonds (5's)	15 000,000	1,000	115	115½
Bay State	50,000,000	50	3⅞	4
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works..	450,000	100	..	..
" 1st Mtg. 5's	450,000	1,000	..	..
Boston United Gas Co.—				
1s Series S. F. Trust	7,000,000	1,000	92	..
2d " " "	3,000,000	1,000	..	80
Buffalo City Gas Co.	5,500,000	100	18½	19½
" " Bonds, 5's	5,250,000	1,000	93	93½
Central, San Francisco	2,000,000	..	105	..
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Columbus	1,144,700	100	89	91
1st Mortgage	1,207,000	1,000	101	103½
Consumers. Jersey City	2,000,000	100	80	..
" Bonds	600,000	1,000	102	104
Cincinnati G. & C. Co.	8,500,000	100	202½	203
Consumers, Toronto	1,600,000	50	184½	187
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Consolidated, Baltimore	11,000,000	100	65½	66½
Mortgage, 6's	3,600,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	..
Consolidated Gas Co. of N.J.	1,000,000	100	16	21
" Con. Mtg. 5's	380,000	1,000	75	80
Consolidated G. & E. Co.'s., Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co.	4,560,000	50	65	65½
" Prior Lien 5's	4,546,000	1,000	94¼	94½
Detroit Gas Co., 5's	423,000	1,000	..	..
" Inc. 5's	31,000	100	..	..
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wa	2,000,000	..	75	80
" Bonds	2,000,000	..	88	
Grand Rapids Gas Lt. Co..	1,000,000	50	..	..
" 1st Mtg. 5's	1,125,000	1,000	..	.
Hartford	750,000	25	..	145
Indianapolis	2,000,000	..	115	125
" Bonds, 6's	2 650,000	..	106	107
Jackson Gas Co.	250,000	50	..	..
" 1st Mtg. 5's	250,000	1,000	..	..
Jersey City	750,000	20	180	..
Lafayette Gas Co., Ind.	1,000,000	100	78	83
Bonds	1,000,000	1,000	90	91
Louisville	2,570,000	50	.	..
Laclede, St. Louis	7,500,000	100	47¾	48
Preferred	2,500,000	100	92	94
Bonds	10,000,000	1,000	105½	106
Madison Gas & Elec. Co.	400,000	100	..	..
" 1st Mtg. 6's	350,000	1,000	..	..
Montreal, Canada	2,000,000	100	200	..
Newark, N. J., Gas Co.	1,000,000	..	200	220
Bonds, 6's	4,000,000	..	128	130x
New Haven	1,000,000	25	252	..
Nashville Gas Lt. Co.	1,000,000	50	110	..
Oakland, Cal.	2,000,000	..	53½	55
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	106⅛	106¼
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,00	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	240	250
Rochester Gas & Elec. Co.	2,150,000	50	52	..
Preferred	2,150,000	50	103	..
Consolidated 5's	2,000,000		87½	90
San Francisco, Cal.	10,000,000	100	88½	89
St. Paul Gas Light Co.	1,500,000	100	30	32
1st Mortgage 6's	650,000	1,000	82	85
Extension, 6's	600,000	1 000	..	..
General Mortgage, 5's	2,428,000	1,000	80	82
St. Joseph Gas Co.	1,000,000	100	..	..
" 1st Mtg. 5's	750,000	1,000	..	..
Syracuse, N. Y.	1,750,000	100	15¾	16¾
Bonds	1,612 000	1,000	85	89
Washington, D. C	2,400,000	20	250	..
First mortgage 6's	600,000			
Western, Milwaukee	4,000,000	100	85½	86
Bonds, 5's	3,830,500	.	101¾	102½
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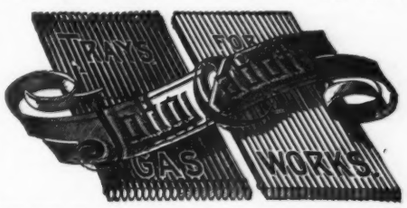

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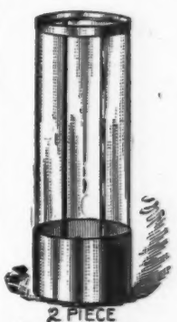

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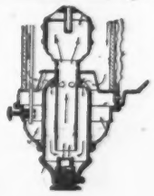

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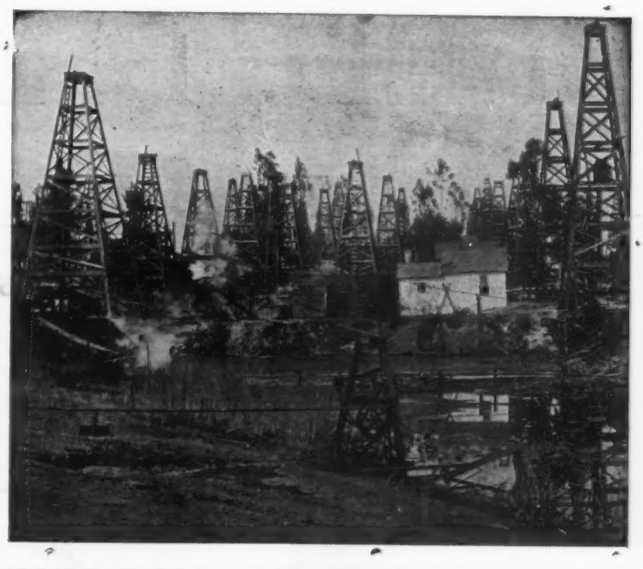

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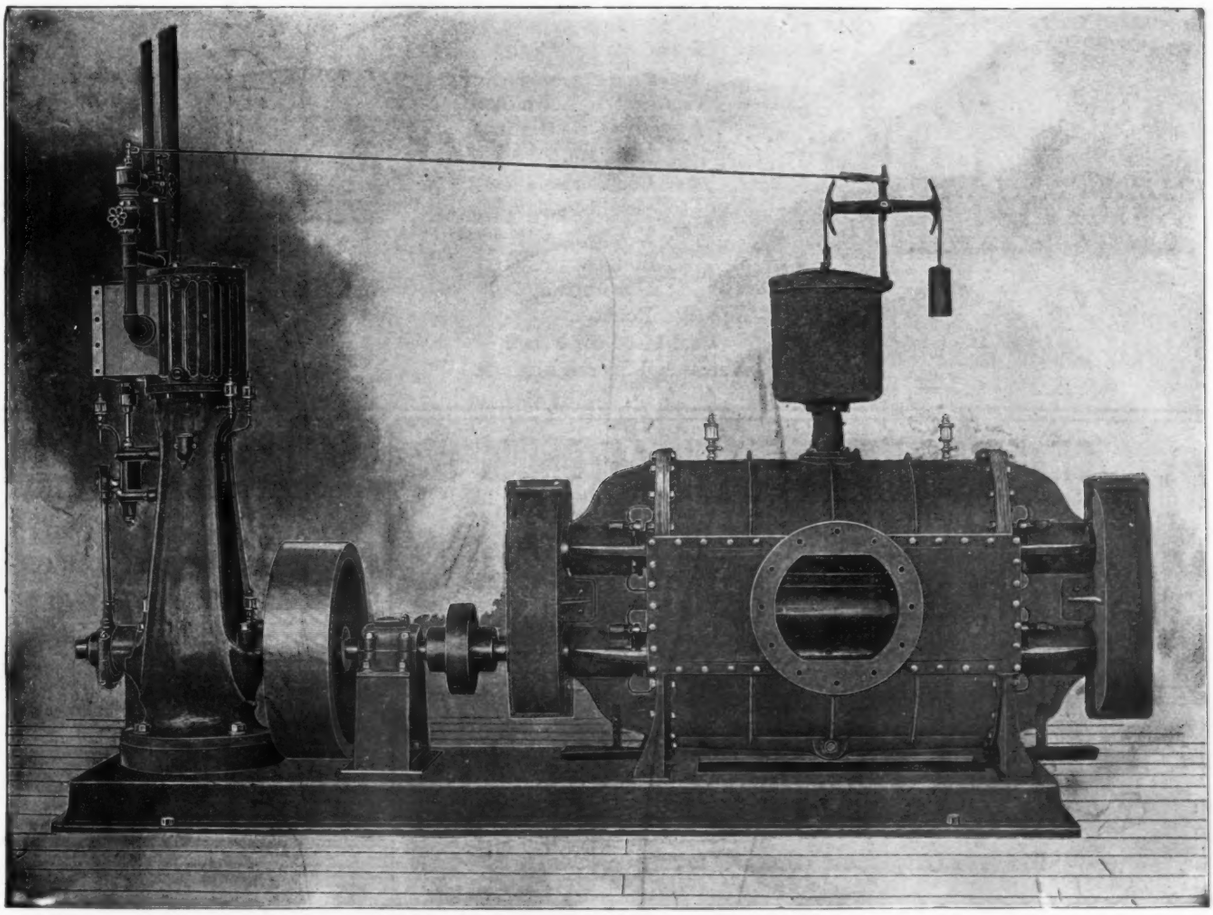

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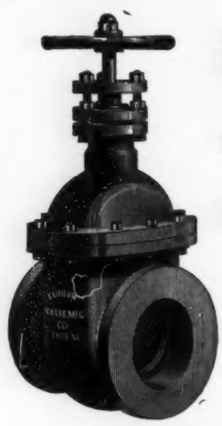

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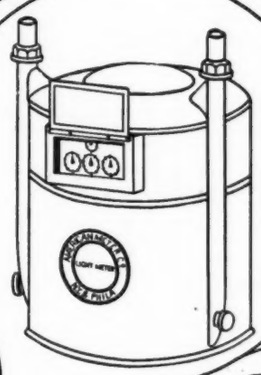

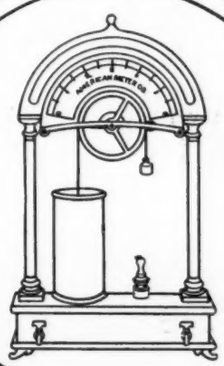

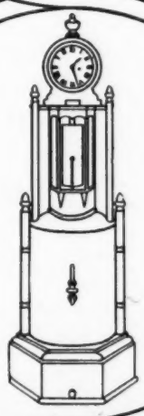

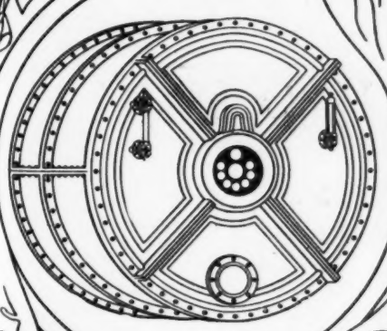

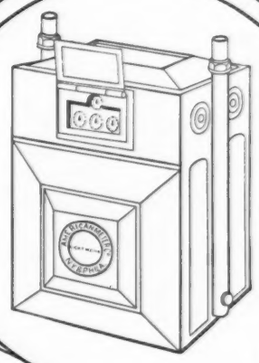

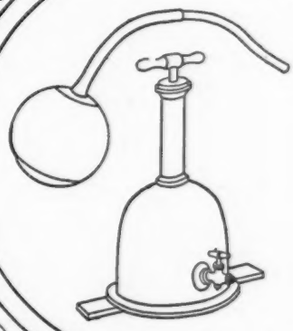

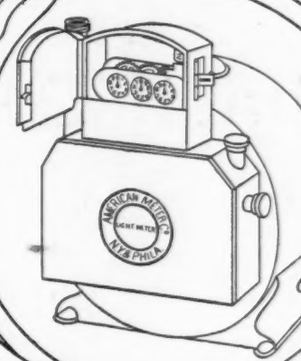

PUBLIC LIGHTING TABLE.

NOVEMBER, 1898.

Day of Week.	Table No. 1. FOLLOWING THE MOON.			Table No. 2. NEW YORK CITY. ALL NIGHT LIGHTING.	
	Date.	Light.	Extinguish.	Light.	Extinguish.
				P.M.	A.M.
Tue.	1	5.30 PM	8.00 PM	4.45	5.35
Wed.	2	5.30	8.50	4.45	5.35
Thu.	3	5.30	9.50	4.45	5.35
Fri.	4	5.30	10.50	4.45	5.35
Sat.	5	5.30	11.50	4.40	5.45
Sun.	6	5.20 LQ	12.50 AM	4.40	5.45
Mon.	7	5.20	1.50	4.40	5.45
Tue.	8	5.20	2.50	4.40	5.45
Wed.	9	5.20	3.50	4.40	5.45
Thu.	10	5.20	5.40	4.40	5.45
Fri.	11	5.20	5.40	4.40	5.45
Sat.	12	5.20	5.40	4.30	6.00
Sun.	13	5.10 NM	5.50	4.30	6.00
Mon.	14	5.10	5.50	4.30	6.00
Tue.	15	5.10	5.50	4.30	6.00
Wed.	16	5.10	5.50	4.30	6.00
Thu.	17	5.10	5.50	4.30	6.00
Fri.	18	8.40	5.50	4.30	6.00
Sat.	19	9.50	5.50	4.25	6.00
Sun.	20	11.00 FQ	6.00	4.25	6.00
Mon.	21	12.10 AM	6.00	4.25	6.00
Tue.	22	1.20	6.00	4.25	6.00
Wed.	23	2.20	6.00	4.25	6.00
Thu.	24	3.30	6.00	4.25	6.00
Fri.	25	4.30	6.00	4.25	6.00
Sat.	26	No L.	No L.	4.20	6.10
Sun.	27	No L. FM	No L.	4.20	6.10
Mon.	28	No L.	No L.	4.20	6.10
Tue.	29	5.10 PM	6.40 PM	4.20	6.10
Wed.	30	5.10	7.40	4.20	6.10

TOTAL HOURS LIGHTING DURING 1898.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	210.40	January	423.20
February	186.40	February	355.25
March	181.20	March	355.35
April	166.10	April	298.50
May	156.40	May	264.50
June	144.30	June	234.25
July	147 30	July	243.45
August	157.10	August	280.25
September	169.50	September	321.15
October	186.00	October	374.30
November	204.30	November	401.40
December	218.30	December	433.45
Total, yr.	2129.30	Total, yr.	3987.45

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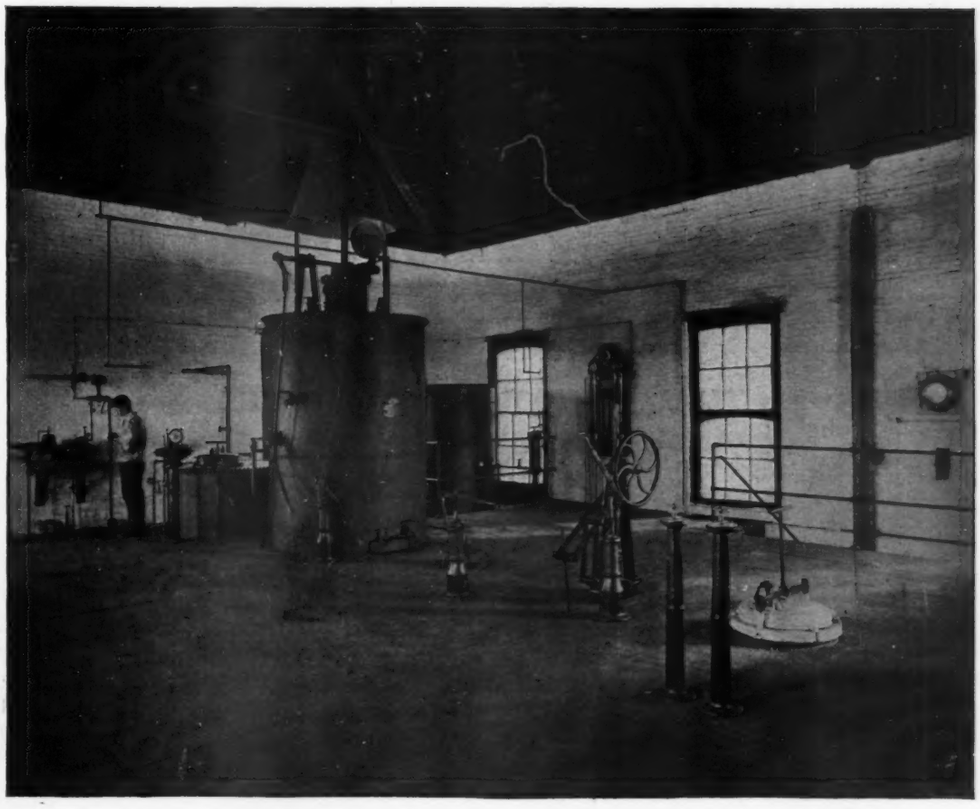

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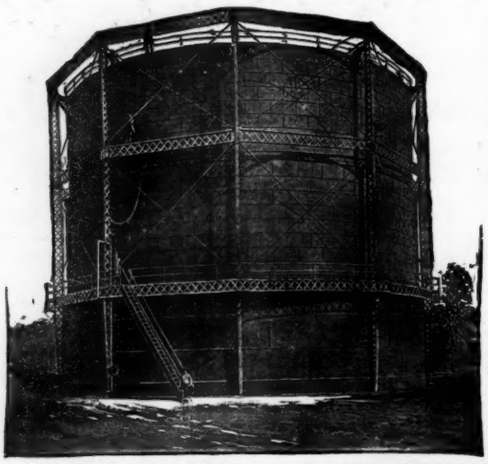

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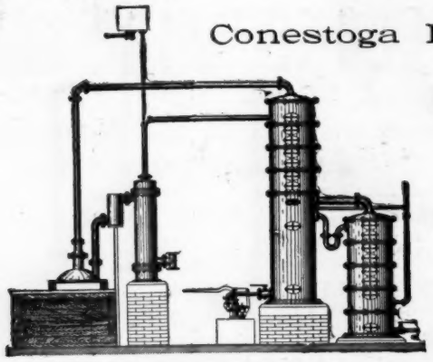

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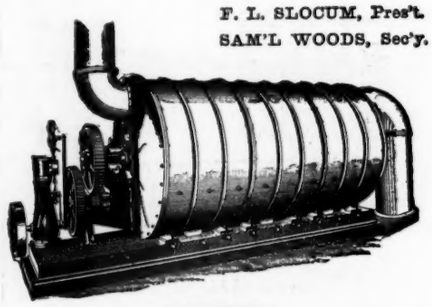

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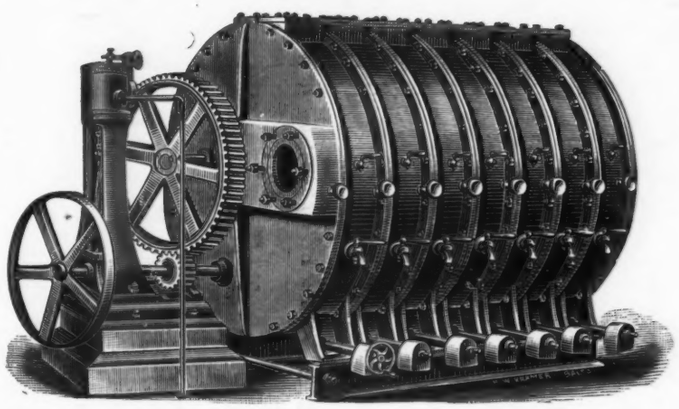

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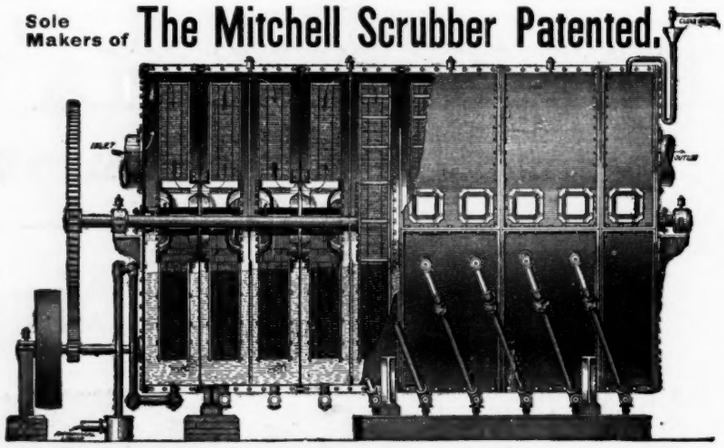

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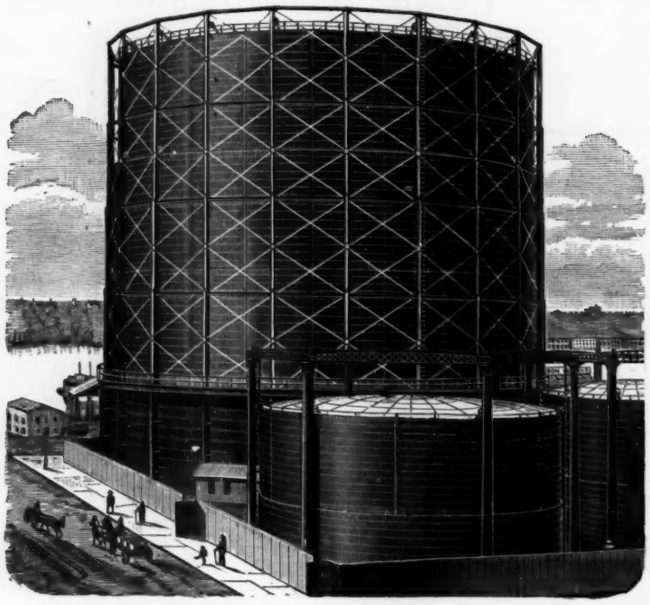

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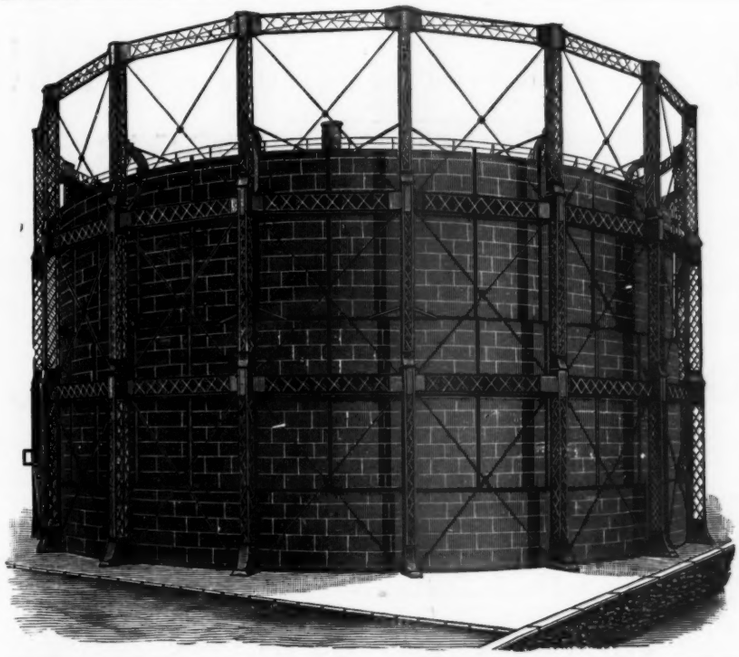

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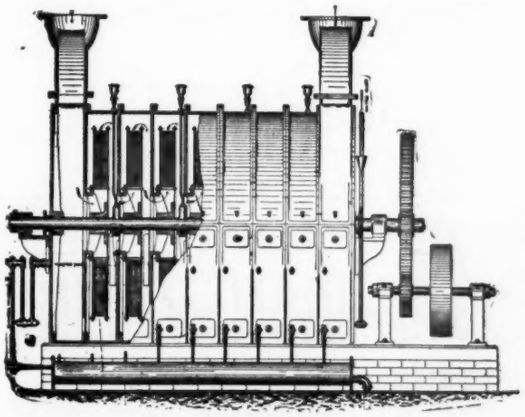

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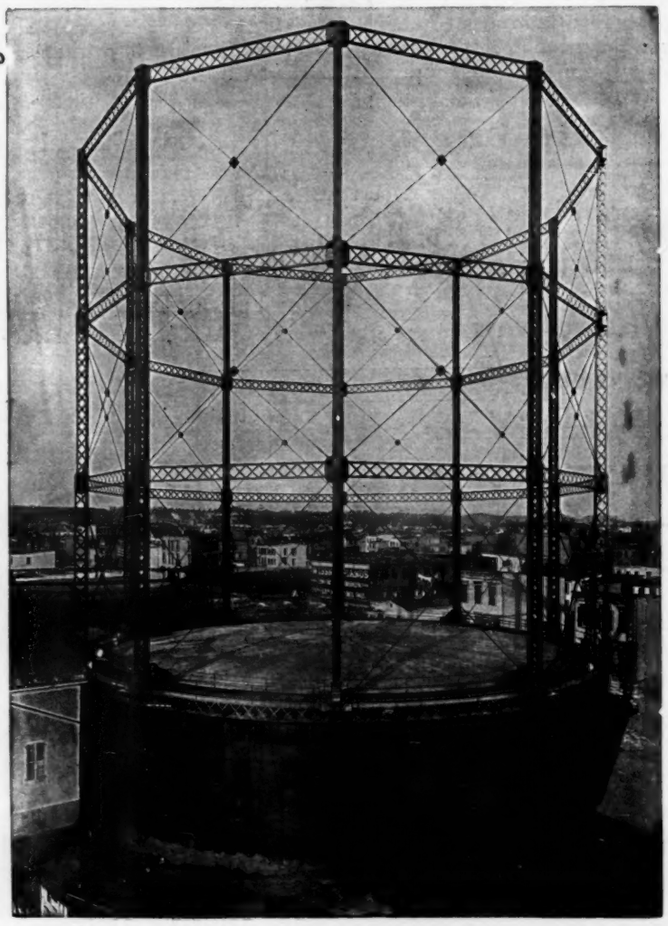

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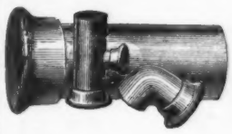

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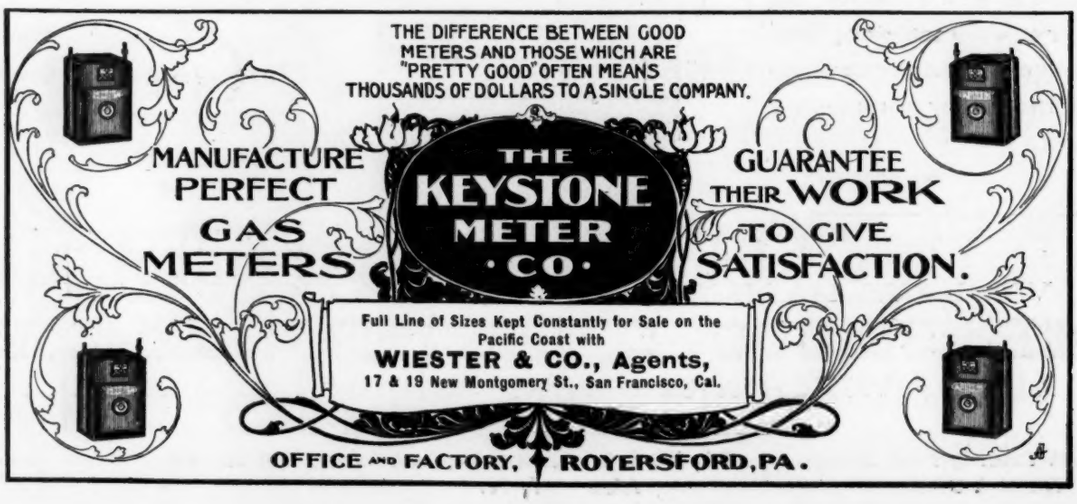
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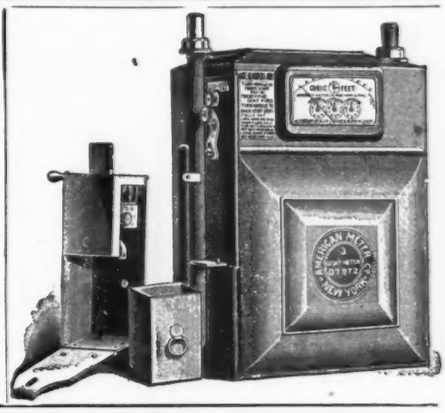

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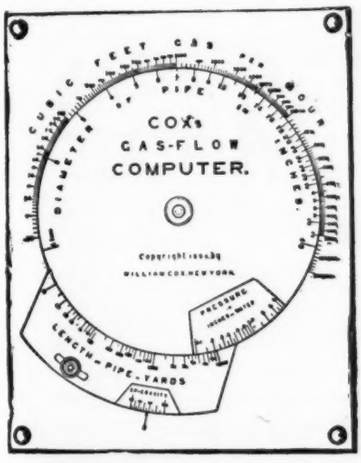

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